LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

CANNED CRAB INDUSTRY OF JAPAN

UNITED STATES DEPARTMENT OF THE INTERIOR
J. A. Krug, Secretary
FISH AND WILDLIFE SERVICE
Albert M. Day, Director

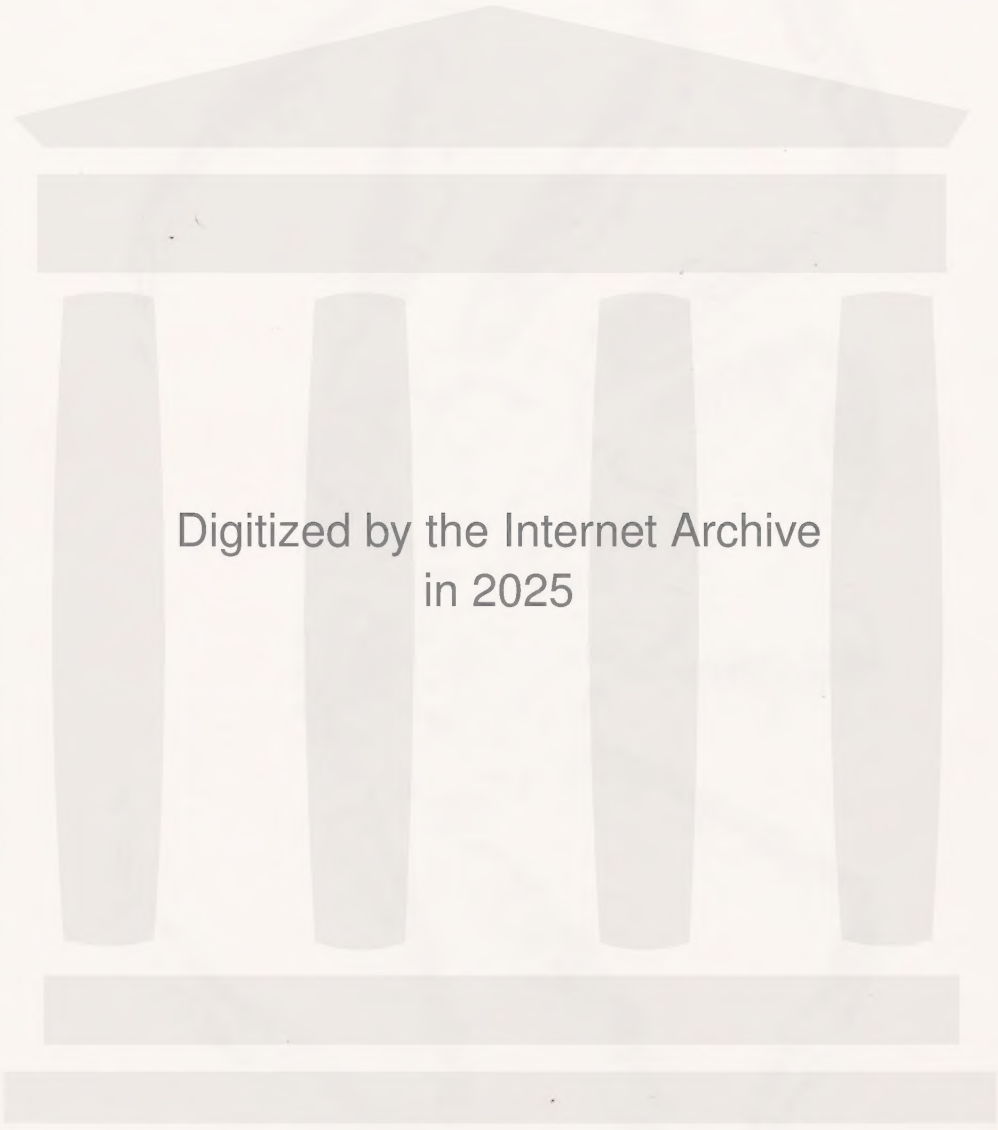
FISHERY LEAFLET 314

Washington 25, D. C. August 1948

ADULT MALE TARABA CRAB, Paralithodes camtschatica

(Carapace width 185 mm. One-third life size.)

P-6161


Digitized by the Internet Archive
in 2025

https://archive.org/details/fishery-leaflet_1948-08_314

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

FISHERY LEAFLET 314

CANNED CRAB INDUSTRY OF JAPAN

Note: This is a reproduction of Report No. 109, Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, Tokyo, issued July 26, 1948. It has been reproduced with the permission of the Civil Affairs Division, United States Department of the Army.

P-6761

CANNED CRAB INDUSTRY OF JAPAN

TABLE OF CONTENTS

Page

Frontispiece

Summary 6

Introduction. 7

Classification and Biology of the Crab Species. 9
1. Classification. 9
2. Biology of Paralithodes camtschatica. 11
3. Artificial Propagation. 15

The Japanese Canned Crab Industry 16
1. General 16
2. Hokkaido and Southern Kuril Area. 16
3. Karafuto (Sakhalin) Area. 19
4. Maritime Province Area. 21
5. Northern Kuril Area 21
6. Kamchatka Area. 24
7. Alaskan Area. 24
8. Korean Area 26
9. Floating Canneries. 28
10. Total Production of Canned Crab Meat. 31
11. Export Trade and Domestic Consumption 31

Operation of Canneries. 34
1. Land-Based Canneries. 34
2. Operation of Floating Canneries 38

Inspection and Grading. 41

Lacquer and Paper Specifications. 41
1. Can Lacquer 41
2. Paper Liner 42

Bacteriological Studies 42

By-Products of Canning. 43

Bibliography. 44

Figures
Figure 1. Japanese Canned Crab Production by Regions, 1902-42 8
Figure 2. Growth of Paralithodes camtschatica 10
Figure 3. Developmental Stages of Taraba Crab 13
Figure 4. Seasonal Depths of Adult Taraba Crab. 14
Figure 5. Hokkaido Crab Fishing Areas and Land-Based Canneries, 1947. 17
Figure 6. Southern Kuril Crab Fishing Areas and Land-Based Canneries, 1909-39 . 18
Figure 7. Karafuto Land-Based Crab Canneries, 1939. 20
Figure 8. Northern Kuril Land-Based Crab Canneries, 1939. 22
Figure 9. Major Crab Fishing Areas in the Bering Sea. 23

TABLE OF CONTENTS (CONT'D)

Figures (Cont'd) Page

Figure 10. Kamchatka Land-Based Crab Canneries, 1939 24
Figure 11. Korean Land-Based Crab Canneries, 1937. 27
Figure 12. Annual Production, Export, and Domestic Consumption of Canned Crab, 1924-42 32
Figure 13. Total Production, Export, and Domestic Consumption of Canned Crab, 1924-43 33
Figure 14. Ground Tangle Net 35
Figure 15. Crab Canning Process, Land-Based Cannery. 36
Figure 16. Fishing Operation, Floating Cannery Fleet 39
Figure 17. Crab Factory Ship 40

Tables

Table A. Species Carapace Characteristics. 11
Table B. Annual Egg Production 12
Table C. Artificial Hatching of Crab Larvae, 1938. 16
Table D. Factory Ships Operating in the Sea of Okhotsk, 1932-42. 22
Table E. Fishing Effort and Crab Catch in Sea of Okhotsk, 1926-34. 25
Table F. Floating Canneries Operating in Alaskan Waters, 1932-40 25
Table G. Catch and Pack of Floating Factories in Alaskan Waters, 1932-40 . . . 25
Table H. Korean Pack of Canned Crab by Cities, 1937. 26
Table I. Market Price of Korean Canned Crab, 1937. 28
Table J. Chronology of Organizations Controlling the Floating Factory Crab Canning Industry, 1930-45 29
Table K. Operating Costs of Factory Ships, 1938-42 30
Table L. Number of Crabs Taken by Factory Ships, 1924-40 30
Table M. Export of Canned Crab Meat, 1906-23 31
Table N. Domestic Consumption of Canned Crab Meat, 1925-43 34
Table O. Cannery Wages, 1945 37
Table P. Sale Price of Canned Crab, 1935-47. 38
Table Q. Production Cost of Canned Crab Meat, 1946 38
Table R. Personnel of A Crab Floating Cannery Fleet. 39
Table S. By-Products of Crab Canning 43

Table 1. Production of Canned Crab Meat by Regions, 1902-42. 45
Table 2. Catch of Taraba Crabs in Karafuto, by Counties, 1914-40 45
Table 3. Data on Crab Fishing Grounds off Eastern Kamchatka (Operations of One Ship, 1939) 46
Table 4. Japanese Factory Ship Operations in Alaskan Waters, 1930-40 46
Table 5. Korean Crab Production, 1912-42 47
Table 6. Factory Ships, Sites of Operations, and Pack, 1920-42 47
Table 7. Data on Typical Crab Factory Ship, Toten Maru 49
Table 8. Export Distribution of Canned Crab Meat by Countries, 1924-43 49
Table 9. Value of Canned Crab Exported to United States. 50

CANNED CRAB INDUSTRY OF JAPAN

SUMMARY

1. Japan was the first country to can crab meat successfully. Because of the need for exportable goods, this industry was developed to the greatest possible extent, and Japanese canned crab meat has been in world-wide demand since 1924. The United States and England have been the leading consumers of this product. From 1924–41, 3,288,997 cases, or 55 percent of the total canned crab export, were shipped to the United States, and 1,648,812 cases, or 27.6 percent, were exported to England.

2. From 1927-39, the Japanese canned crab industry attained an average annual production of 445,102 standard cases of 48 one-pound cans, with the maximum production of 613,089 cases in 1930.

3. Although this amount is not large compared with other Japanese canned products, the foreign exchange resulting from the export of practically the entire production of canned crab meat has made the industry one of considerable importance to Japanese economy.

4. Land-based canneries and floating factory ships shared in the production of canned crab. Before August 1945, land-based canneries were situated in Hokkaido, Karafuto (the southern half of Sakhalin), Kamchatka, the Kuril Islands, and Korea. Floating canneries operated along the eastern and western coasts of Kamchatka and in the Bering Sea off the coast of Alaska and the Aleutian Islands.

5. With the loss of American and British markets, canning activities were suspended in the spring of 1941 except for the packing of a small amount of crab meat in Kamchatka and Korea mainly for domestic use. Operations were resumed in 1942 and continued on a limited scale through 1946. Production during this period was far below normal because of unstable economic conditions and losses of vessels and equipment.

6. All of Japan's crab canning factory ships were sunk during World War II, and all crabbing areas except those immediately adjacent to Hokkaido were lost at the cessation of hostilities. This once extensive industry is now confined to seven land-based canneries on the northern and eastern coasts of Hokkaido.

7. Approximately one-half of the Hokkaido fishing grounds which formerly supplied the local land-based canneries with crabs are now outside the authorized fishing area. Japanese business men estimate that if they were permitted to fish in the entire prewar Hokkaido crabbing area, an annual pack of about 25,000 cases could be obtained. However, part of the Hokkaido crabbing area is now under Russian jurisdiction, and little more than one-half of this amount can be produced from the area remaining to Japan. Because of the shortage of critical materials such as nets, gear, and tin plate, the 1946 pack was only 13,811 cases, and the 1947 pack dropped to 11,630 cases.

This report was prepared by Dr A. R. Cahn, aquatic biologist, Fisheries Division. Capt S. C. Oglesby began compilation of the data. The cooperation of the Nichiro Gyogyo Kubushikigaisha (Nichiro Fishing Co, Ltd), Nippon Kanzume Kabushikigaisha (Japanese Canned Goods Co, Ltd), and Kaiyo Gyogyo Kyokai (Oceanic Fisheries Assn) is herewith acknowledged.

8. The prewar wholesale price of canned crab meat was about ¥50.00 per standard case. (A standard case contains 48 one-pound cans.) With the 1947 production cost at approximately ¥6,020 per standard case, marketing even the small quantity now produced may be difficult.

9. Unless specifically indicated otherwise, statements in this report refer to conditions before 1940, the last year in which conditions were near normal.

INTRODUCTION

Before World War II Japan based a profitable export trade upon the exploitation of the crab resources in the Pacific Ocean area north of Latitude 36°N. Land-based canneries, from which fishing crews operated within a limited radius of the factory, conducted intensive operations. Forty-five known crab canning factories were situated in Japanese territory (Hokkaido, the Kuril Islands, Karafuto) and in foreign territory (Kamchatka) by right of treaty. An indeterminate number of canning factories were situated in Korea. Japan also embarked upon extensive crabbing operations, utilizing factory ships to exploit the area from the Japan Sea through the Sea of Okhotsk to the Bering Sea. Floating crab canneries, which are basically Japanese in origin, were perfected by them to meet the ever-increasing demand of foreign markets and were operated at a high degree of efficiency.

The crabbing grounds which had provided the bulk of the catch (Figure 1) were no longer available to the Japanese at the termination of the hostilities of World War II. The former land-based factories in Korea, the Kurils, Karafuto, and Kamchatka were lost as a result of the Potsdam Declaration. The floating canneries which were requisitioned by the Japanese navy during the war had been sunk. Moreover, Japan's authorized fishing areas no longer allow operations in the major crabbing grounds. The former extensive operations by factory ships from northern Korea along the coasts of Russia's Maritime Province, Sakhalin Island, and the Kamchatka Peninsula, across the Bering Sea and the Aleutian Island area to Kodiak Island, and northward to Bering Strait are no longer possible.

Japan's crab fisheries since the end of hostilities in World War II have been limited to minor fishing grounds off the northern and eastern coasts of Hokkaido. Production of seven land-based canneries in this area was 13,811 cases in 1946 and 11,630 cases in 1947, in contrast to the average annual production of 373,633 standard cases from all former Japanese crabbing areas during 1924–42, the peak years of prewar operation.

Because of the high export value of canned crab meat, domestic consumption has always been meager, averaging about eight percent of total production. The Japanese exported 5,971,121 standard cases from 1924–43. Fifty-five percent went to the United States, and 27.6 percent to England. Smaller quantities, amounting to 17.4 percent of the total pack, were sent to Canada, Australia, Hawaii, France, Germany, Denmark, Sweden, Belgium, Holland, Greece, China, Manchuria, and other European, African, Asiatic, and South American countries.

Five species of crabs were used in the canning industry. The taraba-gani (*Paralithodes camtschatica*), a northern king crab of delicious flavor and large size (Frontispiece), made up the major part of the total pack, while the somewhat smaller hanasaki-gani (*P. brevipes*) and the abura-gani (*P. platypus*) together composed about nine percent. The remaining insignificant portion of the pack was made up of the inferior zuwai-gani (*Chionectes opilio*) and the hairy ke-gani (*Erimacrus isenbeckii*). The last two species were those most abundant in the Korean industry.

The taraba-gani is a slow-growing species. It requires about 10 years to attain sexual maturity at a carapace (body shell) width of 100 to 110 millimeters. Crabbing activities had hardly reached intensive production before the Japanese Government realized the damage that over-fishing could do to a slowly growing and maturing species. The taking of females of any size was prohibited because mature individuals carry eggs during

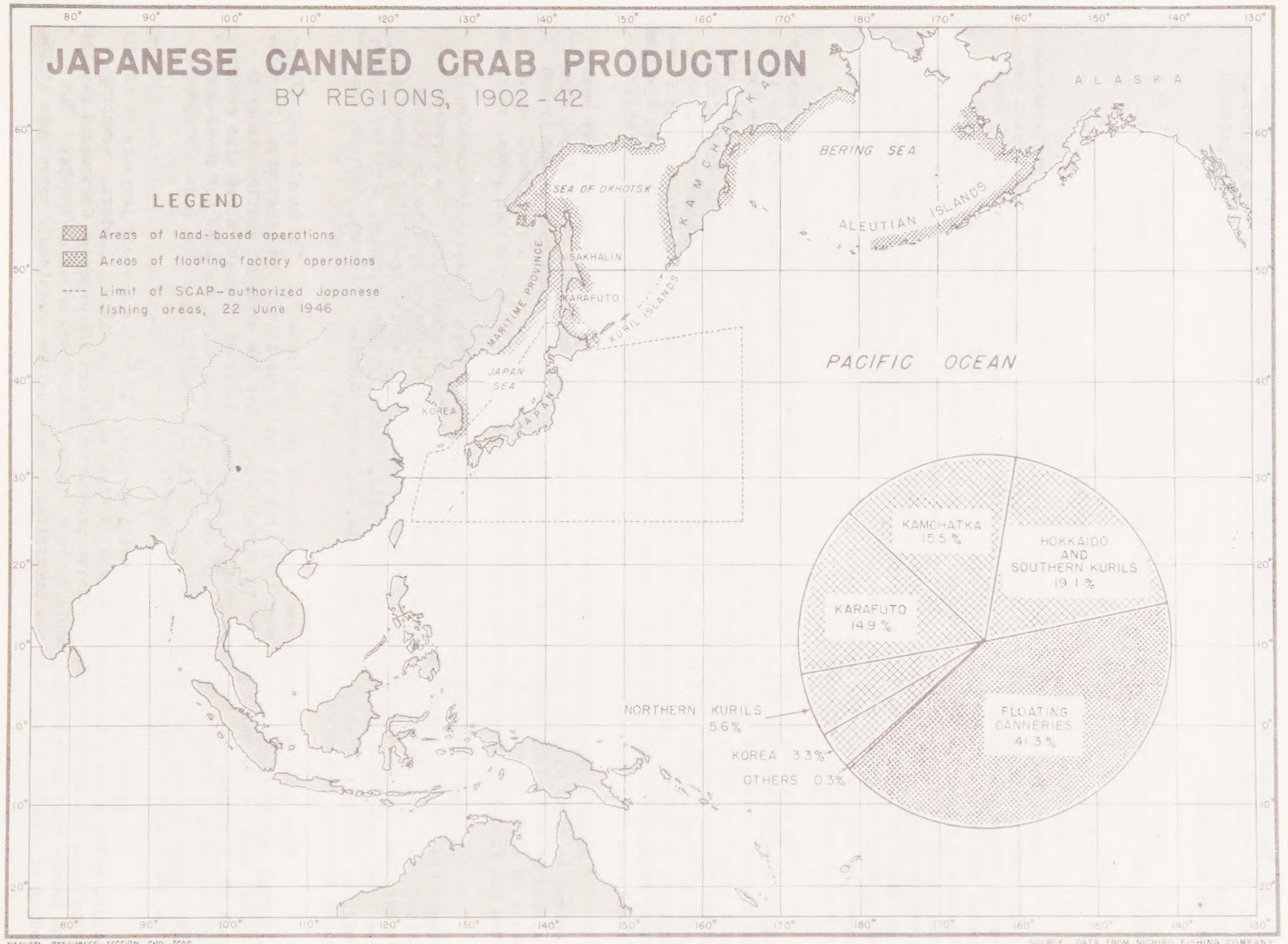


Figure 1

P-1969

most of the year and immature individuals are too small in size to warrant their canning. Males under 155 millimeters in carapace width were also protected. The entire industry was thus based upon mature male individuals which had taken about 14 years to grow to legal minimum size (Figure 2).

An additional conservation measure was introduced by the Government in 1922 by restricting the mesh size used for capturing crabs to a minimum of 18 incnes, stretched. At the same time a gradual amalgamation of organizations engaged in the fisheries took place, until in 1932 all factory ships were under the control of the Japanese Consolidated Floating Factory Co, Ltd. After 1941 all land-based canneries were under the control of a single company, the Nichiro Fishing Co, Ltd. This consolidation of companies into two major operating units eased the task of enforcing the conservation measures.

The technique of catching crabs has changed little during the history of the industry. Tangle nets with a stretched mesh of not less than 18 inches have been used exclusively in the fishery. These nets were set in a long series and left for indeterminate length of time, depending on weather conditions. Although hand labor was used in preparing the crabs, the entire process was placed upon an assembly line basis both in the land-based canneries and aboard the factory ships, and speed, efficiency, and complete utilization of material were achieved. The actual canning process was the same in factory ships and in land-based canneries.

Pertinent facts concerning resources, production, and processing methods of the prewar crab canning industry have been compiled in this report. Japanese records, statistics, and literature have provided source material, and voluminous records on yearly catches and packs, activities of the floating canneries, export figures, and other information concerning the industry have been translated and abstracted. A reference list of important publications dealing with the industry is appended. Catch and pack figures, as well as all other specific data, were obtained from the Japanese sources noted. Whenever practical, the data have been cross-checked from all available sources to insure the greatest possible accuracy.

CLASSIFICATION AND BIOLOGY OF THE CRAB SPECIES

1. Classification

Crabs used for canning by the Japanese are listed in the order of their importance to the industry:

Class	Order	Tribe	Super Family	Family	Genus	Species	Japanese Name
CRUSTACEA							
	DECAPODA						
		PAGURODES					
				LITHODIDAE			
					Paralithodes	camtschatica	Taraba-gani
					Paralithodes	brevipes	Hanasaki-gani
					Paralithodes	platypus	Abura-gani
		BRACHYURA					
			OXYRHYNCHA				
				MAJIDAE	Chionectes	opilio	Zuwai-gani
			BRACHYRHYNCHA				
				ATELECYCLIDATE			
					Erimacrus	isenbeckii	Ke-gani

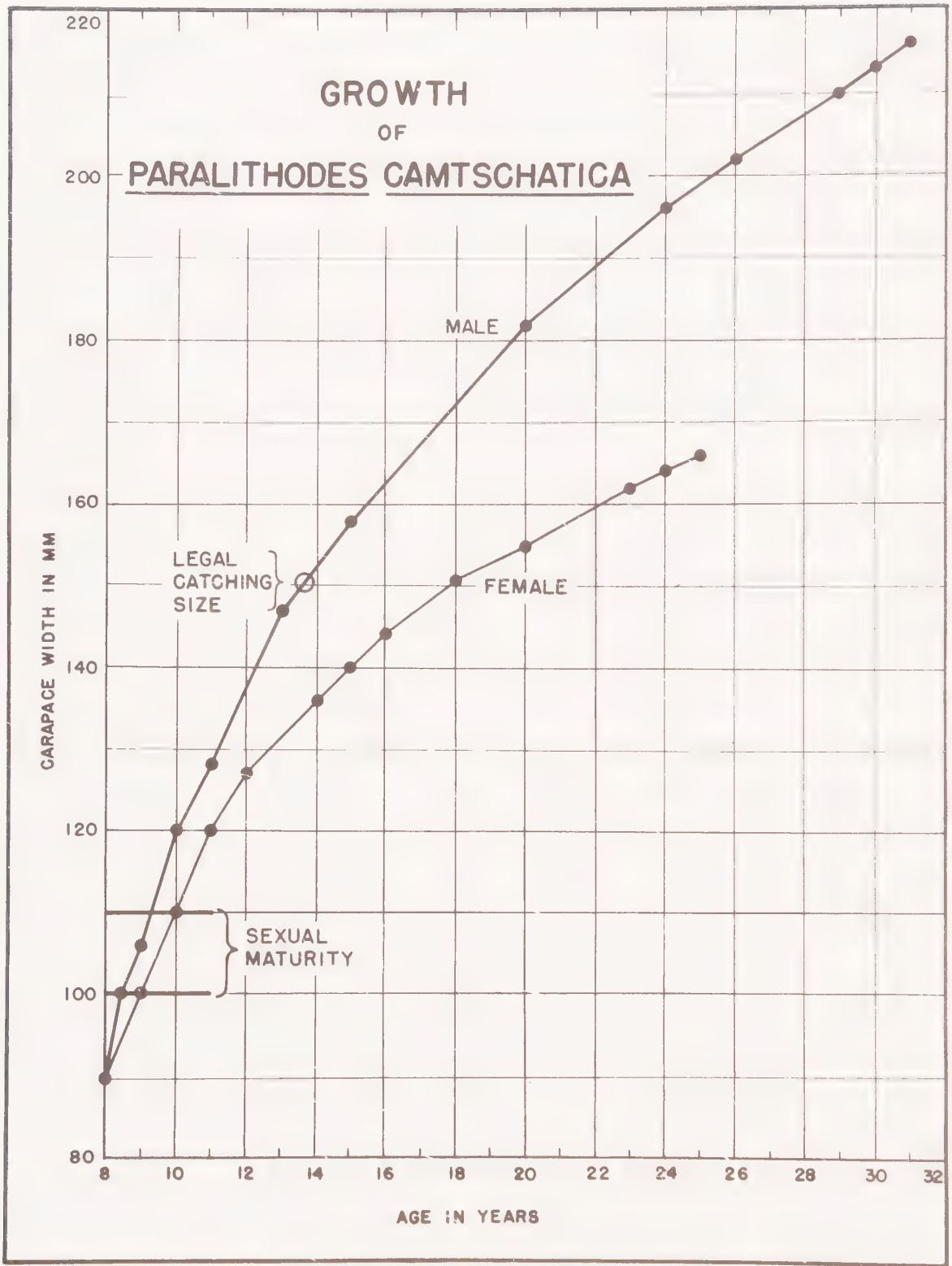

GROWTH
OF
PARALITHODES CAMTSCHATICA
MALE
FEMALE
LEGAL
CATCHING
SIZE
SEXUAL
MATURITY
CARAPACE WIDTH IN MM
AGE IN YEARS
220
200
180
160
140
120
100
80
8
10
12
14
16
18
20
22
24
26
28
30
32
NATURAL RESOURCES SECTION GHQ SCAP

Figure 2

Of the five species listed, Paralithodes camtschatica comprised 90 percent of the canned crab meat, and P. brevipes comprised eight percent. The two species are so similar in appearance that often they are not distinguished by the Japanese and are grouped together as "taraba-gani". The much smaller P. platypus accounted for one percent, and the Chionectes and Erimacrus together constituted the remaining one percent of the canned crab meat.

The king crab P. camtschatica is the most abundant and the largest species in the northern waters. It is distributed from the eastern coast of Kamchatka to the southeastern tip of the Korean Peninsula, its southern limit, where only small numbers are found. Its northern limit is Bering Strait, and it occurs southward along the Alaskan coast to Kodiak Island and westward through the Aleutian chain. Its meat is white and of delicious flavor, superior in quality to all other species. P. platypus also is highly prized for its excellent meat. This species is more restricted in distribution, however, being confined to the cold water areas of eastern Kamchatka, the northern Kurils, the shore region off Abashiri, Hokkaido, and the eastern coast of Karafuto and Sakhalin.

Paralithodes brevipes is limited to the Nemuro coast of Hokkaido, to the southern coast of Kamchatka, and to the Kurils. Although it is much smaller than the preceding two species, it is commercially important. Erimacrus isenbeckii is a small, hairy-bodied crab of definitely inferior quality, living in the coastal waters of northeastern Hokkaido and Korea. Chionectes opilio inhabits the Japan Sea and is abundant on the Japanese coast from Niigata to Tottori prefectures. The male attains a carapace length of 122 millimeters and width of 130 millimeters, while the female is about 75 by 78 millimeters. Canning of these two last-named species was recently started in Korea, but their market value is comparatively low. The two most important species can be distinguished on the basis of simple carapace (body shell) characteristics alone:

TABLE A. - SPECIES CARAPACE CHARACTERISTICS

Body Regions	Number of Spines on Carapace	
	P. camtschatica	P. brevipes
Posterior region	8	14
Posterior-lateral region	10	12
Branchial (gill) region	18	12
Cardiac region	6	4

King crabs inhabit the cold seas where the optimum temperature is about 3°C (maximum 10°C) and live on the sandy-mud bottom of the continental shelf 1/ to a maximum depth of about 200 meters. The water temperature below a depth of 50 meters in the cold current areas is constant at 3°C. Thus the extent of the continental shelf, the water temperature, and the type of bottom determine the distribution of the crabs.

As P. camtschatica comprised 90 percent of the total meat canned, the following life history account is confined to this species.

2. Biology of Paralithodes camtschatica

The most comprehensive biological studies of the Kamchatka king crab, Paralithodes camtschatica (Tilesius), the taraba-gani of the Japanese, are in the publications of Nakazawa (1912), Marukawa (1919-33), Kaijita and Nakazawa (1932), Takenouchi (1935), Sato (1939-1943), and Okamoto (1944). Considered together, these publications give a comprehensive treatment of the biology and economic importance of this species.

1/ The Japanese follow the concept of the continental shelf as being delimited by the 100-fathom (200-meter) contour.

The king crab becomes sexually mature at the age of about 9 or 10 years, when it has attained a carapace width of 100 to 110 millimeters. The act of breeding, which takes place in the spring in relatively shallow water, is initiated by a "handshaking" courtship, varying from three to seven days, during which the male grasps the chela of the female with his own great claw until egg laying takes place. The eggs emerge from the oviduct and, being highly adhesive, stick as a great mass to the hairs of the swimmerets on the under surface of the tail (telson) of the female. The male emits an adhesive and elastic spermatophore band, which overlies the eggs, thus accomplishing fertilization.

The males are polyandrous. Data given by Marukawa (1927) show that the sex ratio in the Nemuro Sea near the southern Kurils is 1.45 males to 1.00 female, and there is evidence that the males slightly outnumber the females in other areas.

Eggs are laid in the spring and are carried on the swimmerets under the tail of the female until the following spring while development of the larval (zoea) stage goes on within the egg (Figure 3). The following spring, as soon as the zoea larvae have hatched and the swimmerets are freed, the courtship and breeding are repeated. The eggs are violet blue at the time of deposition, gradually turning to orange red as the zoea develops internally. The number of eggs produced yearly varies with the age of the female, from 70,000 in a young individual to 290,000 in an older female. The number of eggs produced annually by females of various sizes is:

TABLE B. - ANNUAL EGG PRODUCTION

Width of Carapace (millimeters)	Weight of Female (grams)	Number of Eggs Produced
115	900	69,598
142	1,450	143,293
168	2,288	279,204

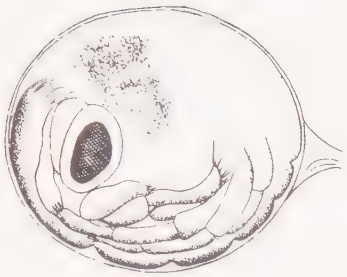
The hatching season is from mid-March to early May, the peak of hatching normally being about 20 April. A single clutch (all the eggs carried by one female) hatches within a five-day period. The zoea has a carapace width of 1.12 millimeters at the time of hatching.

This zoea is the first free-swimming stage of the crab; it bears little resemblance to the adult (B, Figure 3). Growth is attained by the molting (ecdysis) of the hard outer shell, the size increasing with each successive shedding. Saito (1943, pt 3, pp 13-22) has shown that the length of time the larva spends in the various zoea stages depends on the temperature of the water: the warmer the water the shorter the time. The first stage varies from 24 days at 2°C to seven days at 9°C; the second stage from 14 days at 5°C to 12 days at 6°C; the third stage from 14 days at 6.9°C to 10 days at 9.23°C; the fourth stage from 14 days at 8.8°C to 9 days at 11.3°C. Thus four stages of zoea development encompass three molts. On emergence from the fourth molt the larva for the first time has a symmetrically developed abdomen and is designated as a glaucothoe larva. Its carapace is 1.7 millimeters long and 2.0 millimeters wide (C, Figure 3). As in the zoea stages, the duration of this glaucothoe stage varies with the temperature, from 18 days at 12.6°C to 12 days at 14.8°C. The fifth ecdysis produces the "Earliest Young Form", which is the first form definitely crab-like in appearance (D, Figure 3), with a carapace 2.2 millimeters long.

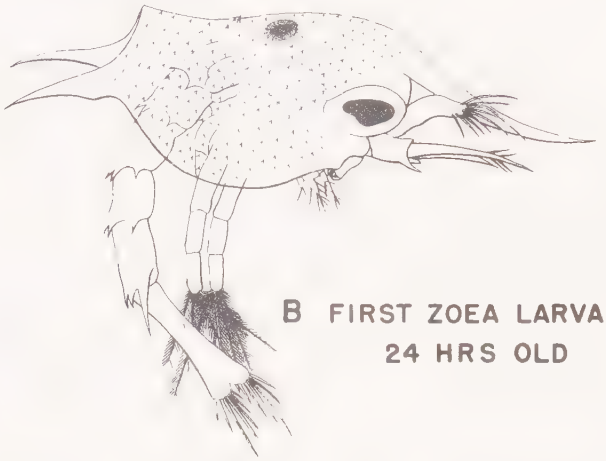
According to Marukawa (1932) the period of maximum mortality occurs at the time of the first molt after hatching. The numbers of larvae obtained from one adult female are: first-stage zoea, 200,000; second stage zoea, 13,000; third-stage zoea, 10,000 fourth-stage zoea, 8,320; glaucothoe larvae, 7,156.

DEVELOPMENTAL STAGES OF TARABA CRAB (PARALITHODES CAMTSCHATICA)

(After Marakawa 1933)



A ZOEA EGG



B FIRST ZOEA LARVA: 24 HRS OLD

C GLAUCOTHÖE LARVA

D EARLIEST YOUNG FORM

NATURAL RESOURCES SECTION GHQ SCAP

Figure 3

The various free-swimming zoea stages inhabit the middle and bottom zones of relatively shallow water, while the glaucothoe larvae and the Earliest Young Forms live only in the bottom zone. All three are found where algae, sponges, and bryozoans are freely distributed over the bottom at a depth of 36 to 80 meters. Following the attainment of the Earliest Young Form, growth is merely increase in size and assumption of the adult physical form through a series of moults (D, Figure 3). The adults are found at depths from 30 to more than 200 meters, depending on the season of the year. With the approach of the breeding season the females precede the males into the shallower water (30 to 60 meters), and after breeding both sexes move northward toward colder water. When the adults come up into the shallower water from March through June, the canning factories are busy, the maximum production being attained in April (Figure 4).

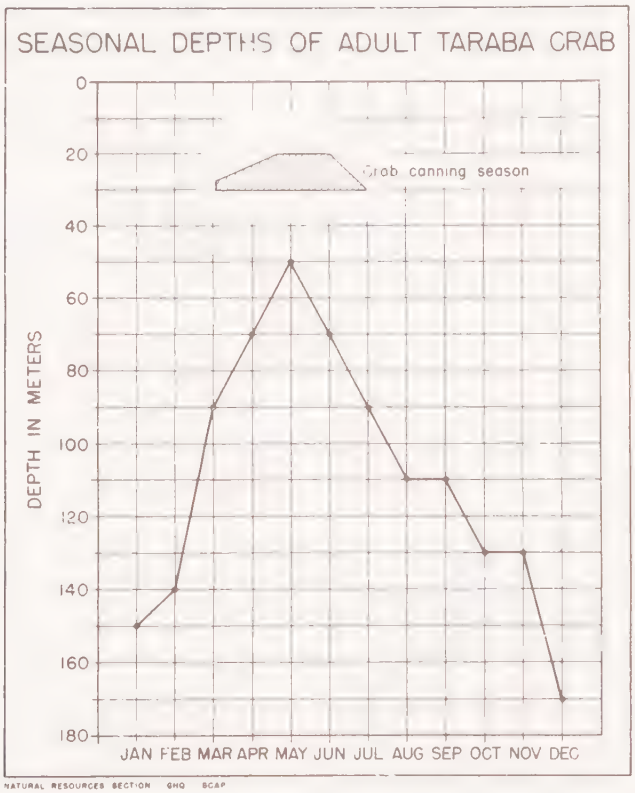


Figure 4

Molting is an exceedingly complicated phenomenon in which not only the carapace, but also the eyes, antennae, mouth parts, esophagus, stomach, calcareous teeth, rectum, gills, and tendons are completely shed. All of these are ectodermal derivatives embryologically and have chitinous elements. Following the molt, which requires only about 15 minutes, the crab is limp and helpless; it neither eats nor moves for two or three days while the new shell slowly hardens, a process which is not completed until about the tenth day.

The crabs of the genus Paralithodes migrate both horizontally and vertically. The horizontal migration is primarily under the stimulus of the breeding urge, while the

vertical migration is mainly a search for food following a period of relative inactivity during the winter. This vertical movement is not directly perpendicular to the bottom but is a modified horizontal movement up the inclined plane of the sloping continental shelf to shallow water, and eventually back again. These migrations are of basic importance to the canning industry.

In the southern Kurils near Kunashiri Island, the horizontal movement from north to south, which occurs in March and April, is the spawning migration. After spawning, the crabs slowly move from south to north in their return to deeper water. These migratory activities were studied by Marakawa from 1927-33 (Okamoto, 1944), by the tagging method. Marakawa found by tagging 4,429 crabs that the maximum speed of migration was 7.1 miles per day for males and 5.6 miles per day for females.

The greatest distance covered by a tagged crab was in the case of a male which was recovered 352 days after liberation at a distance of 300 miles from the tagging point. The longest interval between tagging and recovery was 1,088 days, when a tagged crab was recovered 53 miles from the point of liberation. This, of course, gives no indication of its wanderings in the meantime.

While most of the horizontal migrations are from north to south or vice versa, they may be also from east to west or vice versa, depending on the locality. Thus, the horizontal and vertical movements are combined into a single migration from the deep offshore waters to the shallower inshore waters, irrespective of compass directions. One distinction can be made between these two migration: The horizontal movements are made predominantly by sexually mature individuals, whereas the vertical migrations are predominantly those of subadult crabs having a carapace width of 80 to 115 millimeters. The maximum depth to which Paralithodes descends is not known, but "sleeping" or inactive crabs have been taken at a depth of more than 200 meters.

Most of the northern waters show a heavy concentration of larval crabs, especially those north of Latitude 56°N. This is not a migration northward on the part of these crablets but is a dispersal due to the northward-flowing current which carries the larval crabs with it. At these stages the crabs are planktonic organisms, drifting with the current.

The size and weight of the adult crab vary with locality. The Nichiro Co reports that the average weight figure for adult male P. camtschatica from the Kamchatka area is 2.1 kilograms; the Hokkaido area, 2.3 kilograms; the Karafuto area, 3.0 kilograms. The maximum weight recorded is 7.2 kilograms.

3. Artificial Propagation

In 1934 the Hokkaido Fisheries Experiment Station began studies on the artificial rearing of crab zoea eggs, fertilized eggs in which the zoea larva is slowly developing. Seven branch stations were established to conduct the experiments, but operations ceased in 1940. Similar studies were conducted in Karafuto in 1935. In these experiments, developing eggs attached to the swimmerets were collected and placed in floating hatching-baskets which were anchored in the open sea. Developing eggs can easily be selected because of their reddish-brown color, in contrast to the purple of the dead eggs, and the presence of eye-spots (A, Figure 3). The hatching period differs with the water temperature and with the degree of development of the eggs at the time of taking. As the young hatch, they escape directly into the sea through the meshes of the basket. The results of this artificial method of matching are summarized for 1938 in Table C, page 16.

The artificial hatching experiments proved satisfactory, but the liberated zoea were weak and listless, and it is doubtful if a large percent survived. Therefore, the experiments were continued, and the liberated zoea larvae were held until they had passed the glaucothöe stage after the fifth ecdysis and had thus become the Earliest Young Forms with carapaces about two millimeters long. Such individuals were strong, vigorous, and capable of maintaining themselves in the sea. Although the production rate to this stage

was only 6.1 percent, it proved to be nearly double the production rate in nature, where 7,165 glaucothoe larvae survived out of a total 200,000 original eggs, this being only 3.6 percent survival. This pioneer work has at least proved the feasibility of artificial propagation, and future refinements of techniques may raise the survival rate considerably.

TABLE C. - ARTIFICIAL HATCHING OF CRAB LARVAE, 1938
(Paralithodes camtschatica)

Station	Period	No Eggs Collected	Zoea Hatched	Percent Hatched
Wakkanai	27 Feb-31 Mar	49,100	41,800	85
Aidomari	16 Mar-15 May	92,200	75,500	82
Shimadomari	16 Mar- 3 Jun	72,000	57,600	80
Uenbetsu	26 Apr- 4 Jul	42,800	36,800	86
Murakami	25 Apr-18 May	28,100	22,500	80
Yoman	2 Jun-10 Jul	600	540	89
Towaranbe	4 Jun- 7 Jul	5,100	4,900	95
TOTAL		289,900	239,640	Avg 85

SOURCE: Okamoto, 1944

THE JAPANESE CANNED CRAB INDUSTRY

1. General

Crab canning in Japan dates from 1880, when a sample of canned crab meat, produced in the Fisheries Laboratory at Nemuro, Hokkaido, was exhibited at the Second Industrial Exposition in Tokyo. The first crab cannery was established in 1884 in Fukui Prefecture. This event was followed by the opening of several other canneries in the immediate area, and the industry flourished briefly. However, the crab canned there, the zuwai-gani (Chionectes opilio), was of poor quality and was far inferior for canning to the taraba-gani (Paralithodes camtschatica) of the northern regions. With the establishment of canning factories in Hokkaido, Karafuto, and Kamchatka after the Russo-Japanese War, canning activities in the Fukui district ceased.

2. Hokkaido and Southern Kuril Area

The Hokkaido industry was centered near the city of Otaru until 1891, but with the increasing demand for the superior taraba crab, canneries spread rapidly northward along the coast. Canned crab was exported to the United States for the first time in 1906. The annual pack in this area increased from 37,437 cases in 1916 to 172,885 cases in 1934 (Table 1). As early as 1922, fear of overproduction and evidence of depletion of the supply caused the Government to take restrictive measures which resulted in the amalgamation of all canneries under one controlling organization, the Japanese Canned Crab Products Assn. This organization was succeeded in 1929 by the Hokkaido Kanzume Co, Ltd. The control of the industry changed hands several times until 1941, when the Government ordered all land-based crab and salmon canneries in the northern Pacific area placed under control of the Nichiro Fishing Co.

The distribution of the crab fishery and its supporting canning activities was determined by the productive area of the continental shelf. The best of the early fishing grounds extended from the coast of Rishiri Island to Abashiri, passing Cape Noshappu to the northeast, this being a continuation of the Sakhalin continental shelf area and fishing grounds (Figure 5). The second most important ground was the region southeast of Kunashiri Island. The water surrounding Suisho, Shikotan, and Kunashiri islands averages from 40 to 60 meters deep, the bottom is flat and sandy and without obstacles to operations, and the crabs are abundant. The third region, which lies offshore from Kushiro, is inferior to the two preceding areas. Here the crabs were caught in fish seines. At the start of the fisheries in this area the crabs were used for home consumption and were not canned.

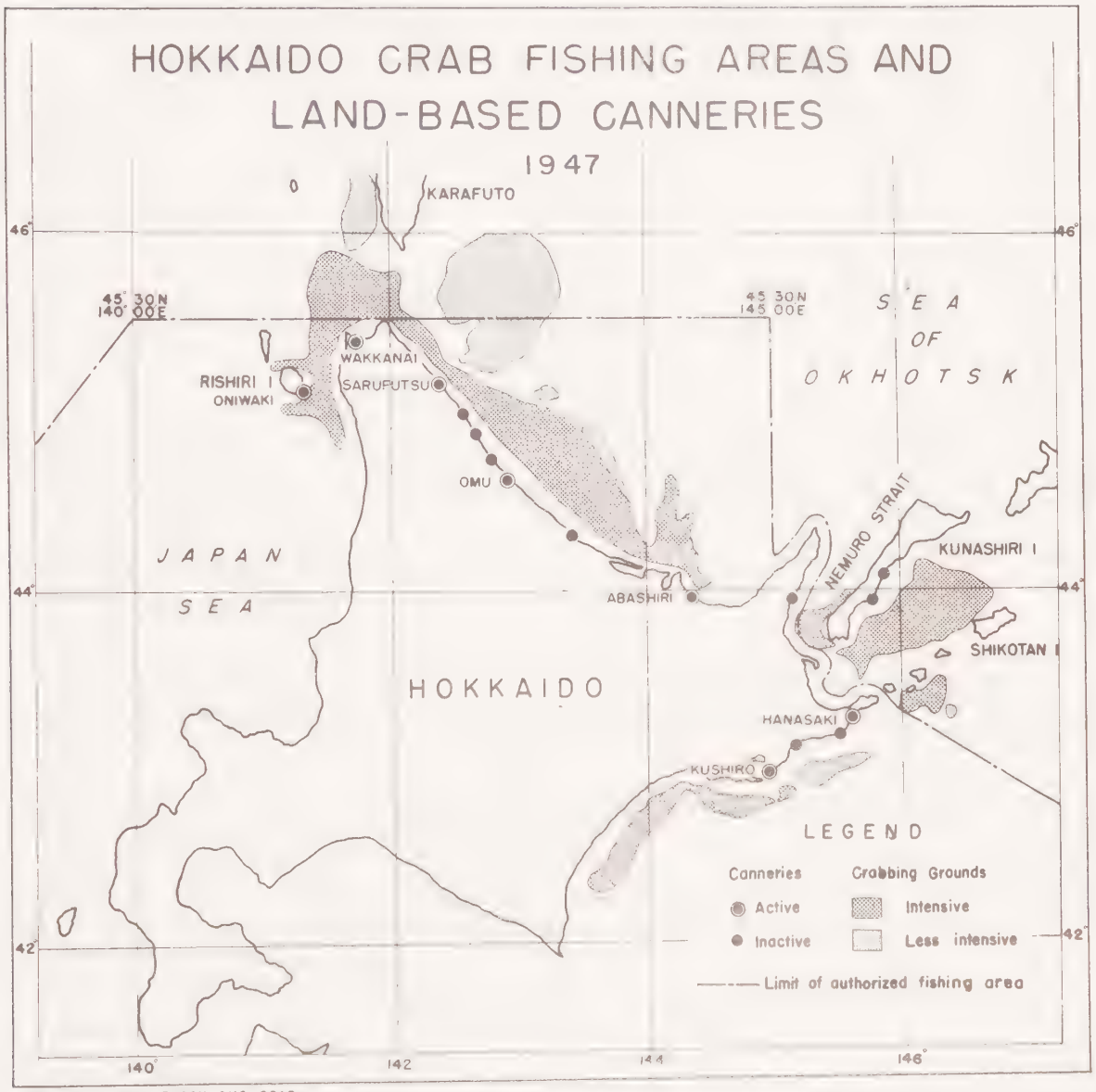


Figure 5

The usual fishing depth is 40 to 200 meters, but on the offshore grounds of the Abashiri area, fishing operations were conducted at a depth exceeding 200 meters. Although the most favorable fishing grounds are those with sandy bottoms, the taraba crab is not confined to that habitat. It is found searching for food over rocky bottom where such forms as sea cucumber (Holothuria monacaria) and sponges abound. Because of the physical difficulties involved, such rocky areas ordinarily are not fished.

The fishing grounds of northeastern Hokkaido center around Nemuro Strait, extending from Kushiro and Akkeshi to the Nemuro Peninsula. In 1948 the entire Japanese crab canning industry was limited to the land bases on Hokkaido and is operated by the Nishiro Fisheries Co. The fishing season there is from March to late June.

Northeast of this Hokkaido area are the southern Kurils and just south of them the five small islands of the Shikotan group, considered politically a part of the Kuril Chain (Figure 6). The crabbing industry in the southern Kurils and the Shikotan group

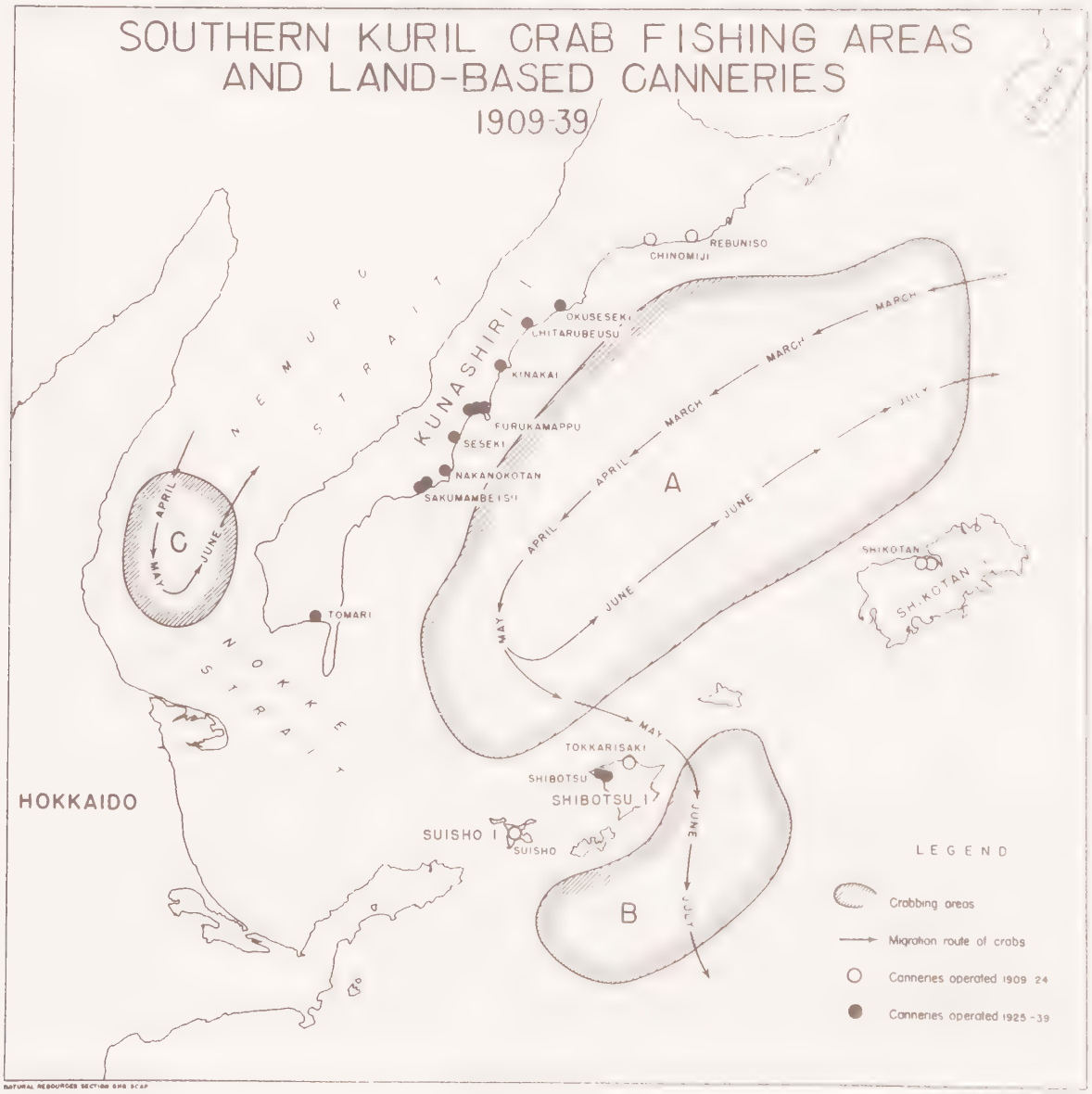


Figure 6

developed in close relationship to the nearby Hokkaido industry, from which they are not ordinarily separable. The Kurils and the Shikotan Islands are now under Russian jurisdiction. Although these crabbing grounds are small in area, they are particularly rich fishing areas and are worthy of consideration.

These crabbing grounds consist of the three areas indicated as A, B, and C in Figure 6. Area A is a large oval region paralleling Kunashiri Island to the southeast. The water is from 35 to 55 meters deep (maximum 90 meters) over a clear sand bottom. Outside this area the depth averages more than 150 meters. The shallower area constitutes an excellent and highly productive crab region. Area B, likewise highly productive, is south of Shibotsu and Suisho islands and includes water from 50 to 100 meters deep. Area C is a much smaller but excellent region in Nokke Strait between the southern tip of Kunashiri Island and Hokkaido.

The crabbing season in these three areas is determined by the seasonal migration of the crabs. The crabs enter Area A from the northeast, coming up from the deeper surrounding water. This movement starts early in March, and the crabs migrate southwestward as the season progresses, reaching the southwestern boundary of the area in late May. When this limit is attained, many of the crabs reverse their migration and move northeast during June, leaving the area about where they entered it in July. Then they descend into the deep water and are out of reach of the fisheries. However, after reaching this southwestern limit, some of the crabs turn south and migrate into Area B, passing east of Shibotsu Island. This provides excellent crabbing during June and July, before this group also descends into deep water. The crabs enter Area C from the Sea of Okhotsk in April, moving south, reverse their course in late May, and retreat to deeper waters of the Sea of Okhotsk again in late June. Scattered crabs are in all areas the entire year, but the big males disappear completely from the crabbing grounds, leaving only small males and females. The large males go into deep water and are called "sleeping" crabs because they are relatively inactive.

The crabbing season along the northern coast of Hokkaido from Wakkanai to Abashiri differs greatly from that in other localities. The crabs seem to be present along this coast the entire year, but fishing operations are interrupted by weather conditions and by physiological factors within the crabs. Ice, a foot or more thick, extends about 15 miles from shore and stops all operations from the time winter storms begin in November until the ice goes out in mid-April. Crabbing starts in April and continues until late June, when the crabs begin to molt. Because the meat is then in poor condition, fishing operations cease until September, after the crabs are again in good condition. Fishing continues until the November storms.

The pack of crab meat in the Kunashiri region reached its peak in 1935. Thirteen land-based canneries on Kunashiri Island alone operated 54 boats and produced 73,652 cases. An average annual pack of about 50,000 cases was maintained from 1934-38. The Japanese believe that this figure represents the potential maximum sustained yield for the area.

Accurate production figures for the southern Kurils are not available because boats from other areas, including Hokkaido, came into this area to operate during the crabbing season. The number of canneries operating in this island region has fluctuated considerably. Between 1900-24, 20 land-based canning facilities were in operation; this was reduced to 14 from 1925-39 and to two from 1940-45. This trend, which does not reflect the productive possibilities of these three excellent areas, is due to consolidations of small factories having limited capital.

The total pack of the Hokkaido and southern Kuril canneries from 1902-42 was 1,638,133 cases, or about 19 percent of the total Japanese pack during that period.

3. Karafuto (Sakhalin) Area

When the treaty which provided for the exchange of Sakhalin for the Kurils was signed by Russia and Japan in 1875, the stipulation was made that Japanese and Russian

vessels were to have the same privileges in the Sea of Okhotsk. After southern Sakhalin (Karafuto) was ceded to Japan in 1905 at the end of the Russo-Japanese War, Japan was given the right to fish along the Russian coast in the Okhotsk, Bering, and Japan seas. As crab fishing was not mentioned in the Portsmouth Treaty, an agreement was reached in 1917 whereby crab fishing privileges were extended to include these areas. After the Kerensky Government fell, later in 1917, Japan had to negotiate an agreement with the Soviet regime to maintain Japanese fishing rights.

From 1922-25 the Japanese placed all their fishing concessions under the protection of the Japanese army as a result of the Nicolaivsky affair, in which all of Japan's leading stations and canneries on Kamchatka were destroyed by Russian partisans. When eastern Russia was taken over by the Soviet Government in 1928, Japan had to renegotiate all fishing agreements. At that time Japan was granted the right to fish along the entire coast of the Far Eastern Soviet territory, except in a few specified ports. Japanese fishing concerns occupied 80 percent of the fishing grounds of eastern Russia until 1928. From 1928-31 the Soviet State Enterprise practically reversed the situation by taking over the leases of the Japanese as they expired. A temporary agreement was signed in April 1929, which provided that the Fisheries Convention of 1929 should remain in force until the end of 1939, and extensions for 1940, 1941, and 1942 were subsequently obtained. During 1940, 142 Japanese vessels employing some 29,000 persons operated in Soviet waters and packed 332,000 metric tons of sea food. When Russia declared war on Japan in 1945 and subsequently occupied the Kuril Islands, an estimated 4,500 Japanese cannery workers were in Kamchatka and the Kurils. As no crabs were canned in Kamchatka and the northern Kurils in 1944 and 1945, no appreciable amount of canned crab was included in the stocks of processed sea food left in those areas.

Because all the coastal waters of Karafuto meet the optimum habitat requirements of the taraba crab, canning factories were located on both coasts (Table 2, Figure 7). The density of the crabs is greatest south of Ushiro Cape on the western coast, in the waters adjacent to Kaihyo Island, and in the waters around West Notoro Cape of Aniwa Bay.

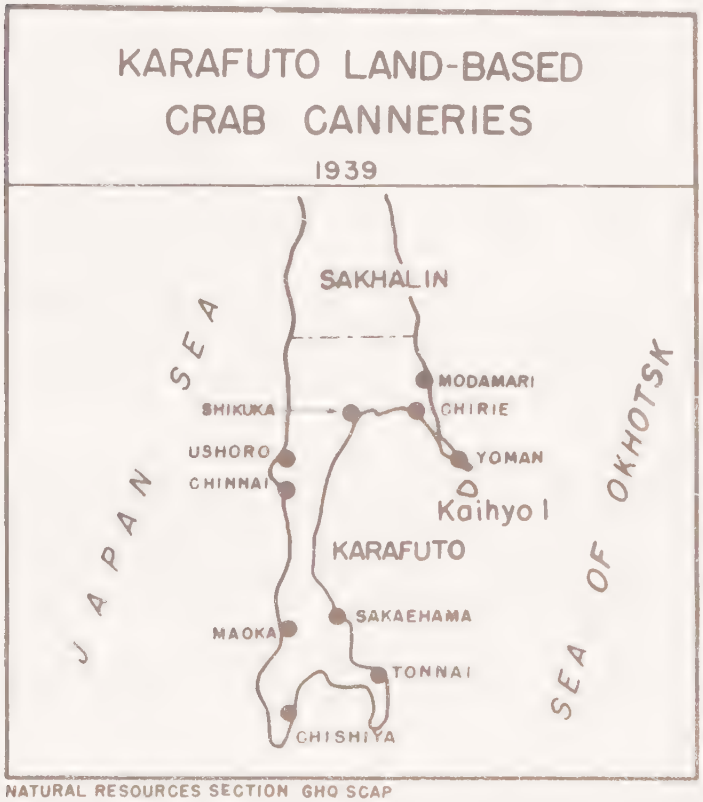


Figure 7

The first crab canning factory on Karafuto was established on a small production scale at Otomari in 1908, following the Treaty of 1905. As the export demand increased, the Karafuto fisheries began developing in 1909. Crabs were taken on salmon long lines and were found mixed with the fish catch of flounder sailing trawlers. Because crab gill net fishing had proved more effective, this method was adopted, using kawasaki boats with crews of five to nine men. These operated with excellent results in the coastal waters. In 1912, 294 gill net fishing boats were in operation, and the catch was 577,134 crabs. The permit system of fishing was started in 1909, the number of permits being limited to 481 persons as a protective measure against the depletion of the resource. Even so, 56 canneries operated in Maoka

alone during 1910. An amalgamation in 1911 reduced the number of canneries on Karafuto to 50. At the same time, the provincial governments prohibited the taking of all female crabs and undersized males with carapace widths less than 150 millimeters. They also proclaimed 21 May-31 August a closed season and established "nursery" or breeding areas wherein no fishing was permitted.

To meet the increased demand for canned crab meat in 1916, canning activities were greatly accelerated. Motor boats replaced the man-driven kawasaki boats, opening up greater fishing areas. The 1917 catch of 5,131,000 crabs, processed by 123 small canneries, yielded 117,515 cases worth ¥3,864,000. This reckless increase in production resulted in overfishing which devastated the good fishing grounds, and the catch dropped to 801,000 crabs in 1926. The Sakhalin Consolidated Industrial Co, which was organized in 1919, lost about 3,000 cases of canned crab meat in the 1923 earthquake and fire in Tokyo. This proved disastrous to the company, and it was reorganized in 1924 as the Sakhalin Industrial Co, Ltd. Because of world conditions, only one factory was in operation in 1942, producing 7,094 cases. The company was absorbed by the Nichiro Fishing Co, Ltd, in 1943.

On the east coast of Karafuto the number of crab canneries increased from 1929, and crab fishing became active over new grounds, especially around Kaihyo Island (Figure 7). On the western coast, as a protective measure, the fishing season was divided into a spring (March-May) and a fall (mid-September-January) season. On the east coast the fishing season was from late April through October.

The annual catch of taraba crabs by the Karafuto canneries for 1914-40 is shown in Table 2. The total pack for Karafuto from 1909-42 was 1,279,074 cases, or about 15 percent of the total Japanese production of canned crab meat (Table 1).

4. Maritime Province Area

From 1922-34, floating factory ships operated spasmodically offshore from Russia's Maritime Province in accordance with treaty agreement. This province borders the Japan Sea north of Korea. Because of the limited fishing area, resulting from the narrowness of the continental shelf and the consequent approach of deep water close to shore, Japanese fishing boats were likely to intrude into Russian territorial waters, and international complications occurred incessantly. These recurrent difficulties resulted in Japan's ceasing all fishing operations in the Maritime Province waters in 1934. The best of the Maritime Province fishing grounds were the offshore waters north of Sovietskaya Bay, which is about 60 miles south of Latitude 50°N. This parallel also marks the northern boundary of Karafuto.

Most of the vessels that operated off this portion of the Russian coast also operated in the Sea of Okhotsk (Table D, page 22). No breakdown in production statistics is available to show the specific production from the Maritime Province waters as distinct from production elsewhere in the Sea of Okhotsk.

5. Northern Kuril Area

The crabbing grounds of the Kuril Islands are limited by bottom and sea conditions to two areas, one in the extreme north and one in the extreme south. The southern area, encompassing the islands of Kunashiri and Etorofu, as well as the five small islands of the Shikotan group, all northeast of Hokkaido, has been discussed. The northern grounds include the offshore waters of the two northernmost Kuril Islands of Shumushu and Paramushiro (Horomushiro), just off the southern tip of the Kamchatka Peninsula (Figure 8). These were developed along with the Kamchatkan industry.

Fishing began in the coastal waters of the two northern islands in 1910 and was gradually extended offshore as overfishing reduced the production of the coastal waters. This seaward extension of the grounds eventually caused the Kuril fishermen to work the same areas as the Kamchatka fishermen, who were operating floating canneries. This congestion caused serious trouble among the fishermen. To remedy this, the Minister of

TABLE D. - FACTORY SHIPS OPERATING IN THE SEA OF OKHOTSK, 1932-42 a/

Vessel	Tonnage	Year									Average Crew
		1932	1933	1934	1935	1936	1937	1938	1939	1942	
Sanuki Maru	5,862	x	x	x							ND
Itsukushima Maru	3,875	x									372
Jinjo Maru	2,742	x	x	x	x	x	x				370
Wakanoura Maru	3,409	x	x	x	x	x	x	x	x		349
Eitoku Maru	2,951	x	x		x			x	x		386
Hakuai Maru	2,614	x		x	x	x	x	x	x	x	379
Mifuku Maru	2,559		x	x	x	x	x	x	x		355
Toten Maru	3,823									x	338
Hokusui Maru	3,944				x	x	x	x			348
Ryokai Maru	4,643					x	x	x	x		394
Hokushin Maru	5,750					x	x				ND
Kasato Maru	6,003							x	x		462

a/ No operations in 1940-41
ND: No data available
SOURCE: Nippon Suisan KK

Agriculture and Forestry modified the control regulations of the crab floating factory ships on 23 March 1938, prohibiting crab fishing by factory ships south of Latitude 51°N and west of Longitude 179°E.

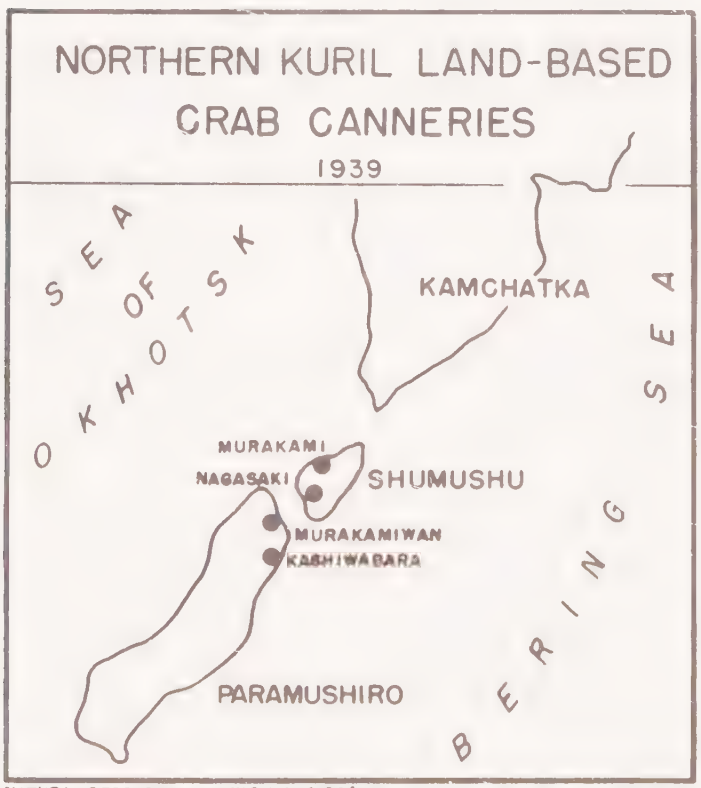


Figure 8

The number of canneries in the northern Kurils had increased from 1 to 18 by 1916, and total annual production was about 10,000 cases. Considering this production excessive for so limited a region, the Government revoked all but four cannery licenses in 1922, and from then until 1942 the number remained constant. However, by improving their methods and increasing their efficiency, these four canneries raised their production to 69,033 cases in 1939 (Table 1). An amalgamation with the Hokkaido crab fisheries in 1941 placed all these northern areas under control of the Japanese Canned Crab Co, Ltd. Shortly thereafter it was decided to suspend operations in this area, and in early 1942 only a single factory was in operation. This factory ceased operations during 1942, when all factories were dismantled because of the war.

The canning factories of the northern Kuril Islands produced 484,251 standard cases of crab meat from 1916-42 (Table 1), or 5.6 percent of the total Japanese production.

NATURAL RESOURCES SECTION GHQ SCAP

Figure 9

P-6191

6. Kamchatka Area

In 1930 the waters of western Bering Sea, off the Kamchatka Peninsula between Longitudes 160°E and 162°E were found profitable for floating factory operations. South of this area the bottom type and the fast currents make crabbing impractical. The best grounds are between Capes Olyutorski and Navarin, a distance of about 300 miles (Figure 9).

Along the western coast of the Kamchatka Peninsula in the Sea of Okhotsk, both the taraba and the abura crabs abound, with relatively few hanasaki crabs intermingled. The abundance of crabs makes excellent fishing off this coast (Figure 10). The number of crabs decreases along the northern and western shores of the Sea of Okhotsk. In the area between Latitudes 54°30'N and 57°N, where fishing is especially good, the season extends from April to September. Crabbing ships arrive at the fishing grounds late in April, and their operations follow the shoreward migration of the crabs toward shallower water. During early May, while the crabs are moving slowly, fishing is done from 15 to 30 miles offshore. From mid-May to early July the operations are only five to seven miles offshore. At this time the crabs are concentrated, and the catch is large.

Figure 10

Table E on page 25 gives data on fishing effort and catch in the Sea of Okhotsk from 1926-34. Table F gives a summary of the seasonal operations off eastern Kamchatka (Bering Sea) for a single floating cannery in 1939. The total pack for Kamchatka from 1920-42 was 1,331,334 cases, or 15.5 percent of the total Japanese pack.

7. Alaskan Area

Factory ships began operations in Alaskan waters in 1932, when the 3,823-ton Nagato Maru first went into the eastern part of the Bering Sea. Operations in these waters were maintained yearly thereafter through 1940 as shown in Table F on page 25.

During 1932-40, 16,237,980 crabs were caught, yielding a pack of 291,607 cases. This Alaskan pack was approximately 3.4 percent of the total Japanese crab meat production as shown in Table G on page 25.

From 1933-37, trawlers accompanied the factory ships into both the Okhotsk and Bering seas, using the mother ship's facilities for the manufacture of fish meal, mostly from herring.

While the area of operations varied somewhat from year to year, it centered in a rectangle bounded approximately by Latitudes 55°N to 60°N and

TABLE E. - FISHING EFFORT AND CRAB CATCH IN SEA OF OKHOTSK, 1926-34

Year	No of Factory Ships	Fishing Region a/		Total No Gill Nets per Boat	Average No Crabs Caught per Gill Net	Total No Crabs Caught
		Northern Limit	Southern Limit			
1926	12	ND	ND	ND	21.0	229,072
1927	15	57°36'	51°36'	ND	21.7	330,228
1928	14	57°53'	51°32'	ND	14.8	303,594
1929	14	59°35'	52°29'	137,005	10.8	325,803
1930	13	57°30'	52°00'	174,159	8.6	312,826
1931	8	57°59'	53°16'	233,521	7.5	207,205
1932	6	57°38'	54°36'	267,885	5.9	139,167
1933	5	58°00'	55°00'	208,524	6.4	102,883
1934	5	ND	ND	231,258	6.7	115,429
TOTAL						2,066,201

a/ Data are given in terms of north latitude.
ND: No data available
SOURCE: Nichiro Fishing Co

TABLE F. - FLOATING CANNERIES OPERATING IN ALASKAN WATERS, 1932-40 a/

Vessel	Tonnage	Year							Avg No Crew
		1932	1933	1934	1935	1936	1939	1940	
Nagato Maru	3,823	x							390
Taihoku Maru	8,263		x	x					381
Shohei Maru	3,771		x						341
Toten Maru	3,823			x	x	x	x		338
Kasado Maru	6,003							x	461
Bifuku Maru	2,559							x	355
Hakuai Maru	2,614							x	348
Wakanoura Maru	2,411							x	349

a/ No operations in 1937-38
SOURCE: Okamoto, 1944

TABLE G. - CATCH AND PACK OF FLOATING FACTORIES IN ALASKAN WATERS, 1932-40

Year	Ships Operating	Days Operated	Crabs per Net	No of Gill Net Units a/	Crabs Caught	Total Pack Standard Cases
1932	1	126	6.2	222,780	1,278,280	34,359
1933	2	290	4.9	575,565	2,806,350	49,403
1934	2	232	2.1	587,410	1,336,958	30,632
1935	1	143	2.6	296,801	778,804	14,444
1936	1	50	2.2	127,918	290,900	7,849
1937	1	75	2.2	217,110	485,900	12,889
1938	1	72	1.9	236,171	411,030	13,385
1939	1	40	1.9	125,300	241,787	6,206
1940	4	498	8.3	1,040,499	8,607,970	122,400
TOTAL		1,526	Avg 3.5	3,429,494	16,237,980	291,607

a/ A "unit" of net is 500 feet long.
SOURCE: Nichiro Fishing Co

Longitudes 160°W to 170°W. This is the Bering Sea area extending from the Aleutian Island group known as the Islands of the Four Mountains to half way up the coast of the Alaska Peninsula. Some fishing was done as far north as Latitude 62°N and Longitude 163°W, the Bristol Bay area of the Alaskan coast. The best grounds proved to be the open sea off Amak Island, Port Moller, and Bristol Bay (Figure 9). However, the fishing grounds in the Alaskan area were unprofitable for mass floating factory activities because the crab population was not sufficient to support large-scale operations, as compared with the greater abundance along the western coast of the Kamchatka Peninsula. For this reason, only a single factory ship was sent into the Alaskan waters specifically for crabbing each year. Consequently, these waters were never greatly exploited.

The detailed activities of factory ships and their auxiliary boats in Alaskan waters are given in Table 4, as illustrative of typical methods employed by the Japanese in such operations.

8. Korean Area

The canned crab industry of Korea was confined to the east coast of that country because the species of crabs suitable for canning are found only along this coast, decreasing in abundance toward the southern tip of the peninsula (Figure 11). Three species are involved: the ke-gani, or hairy crab (Erimacrus isenbeckii), the dominant species for canning purposes; the zuwai-gani (Chionoectes opilio), second in importance; and the taraba-gani (Paralithodes camtschatica), the least important.

The industry in Japan was organized under a single controlling company, but such unification did not prevail in Korea. As a result, no centralized records were maintained, and exact or complete figures on the catch, pack, and export are difficult to determine. Many small independent canneries operated in both large and small cities, without coordination or supervision, and supposedly reported their catch to the Korean Government. The Business Report of the Korean Marine Products Inspector shows a total pack of 285,356 cases worth ¥6,197,000 from 1926-42 (Table 5). Table H gives a breakdown for the 1937 pack of the three kinds of crabs at the most important cities engaged in crab canning.

TABLE H. - KOREAN PACK OF CANNED CRAB BY CITIES, 1937
(standard cases)

Town	Species			Total
	Taraba	Ke	Zuwai	
Chongjin	ND	ND	1,490	1,490
Songjin	42	19	571	632
Sinpo	ND	3,735	4	3,739
Sinchang	ND	715	ND	715
Wonsan	ND	1,255	ND	1,255
Soho	ND	851	ND	851
Tonchang	73	666	ND	739
Samchok	65	ND	ND	65
Satei	ND	1,835	ND	1,835
Kuryongpo-ri	123	ND	ND	123
8 others	117	1,187	808	2,112
TOTAL	420	10,263	2,873	13,556

ND: No data available
SOURCE: Korean Fisheries Statistics 1937

The market price per standard case for the various grades of each species for 1937 is given in Table I on page 28.

NATURAL RESOURCES SECTION GHQ SCAP

Figure 11

TABLE I. - MARKET PRICE OF KOREAN CANNED CRAB, 1937				
Meat	Grade	Yen Value per Standard Case		
		Terata	Ke	Zuwai
Block	Fancy	52.00	NA	NA
	Fair	45.00	NA	NA
	Extra	35.00	NA	NA
Broken	Pack A	47.00	30.00	31.00
	Pack B	30.00	21.50	25.75
	Extra	26.00	ND	ND

NA: Not applicable
ND: No data available
SOURCE: Korean Fisheries Statistics, 1937

9. Floating Canneries

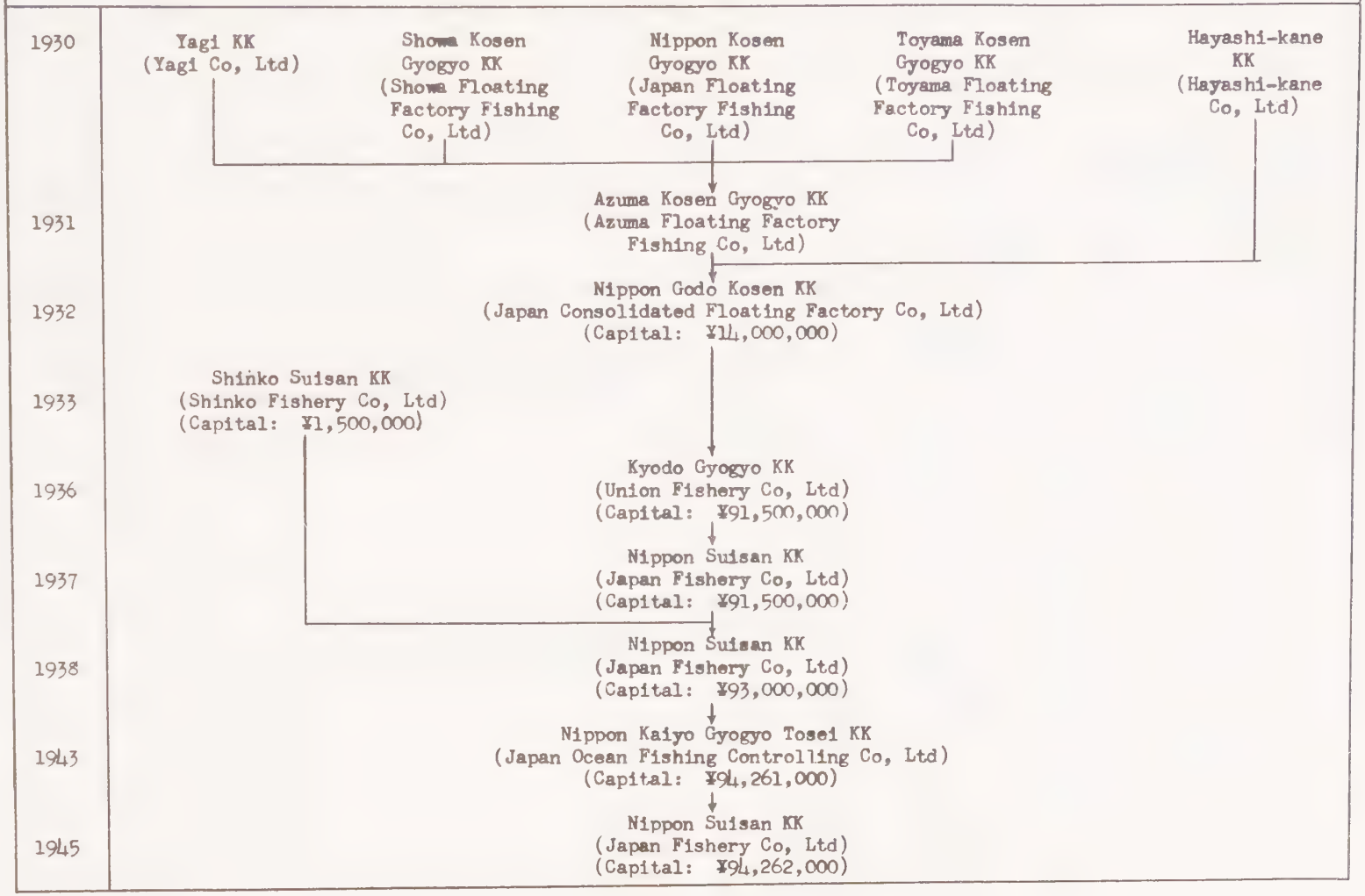
The factory ship, or floating cannery, originated in 1914 with the Unyo Maru, a ship of the Fisheries Institute, Ministry of Agriculture and Forestry, which did experimental canning in the Sea of Okhotsk. The main difficulty encountered was the lack of sufficient fresh water then believed necessary for canning operations. In 1920 the Kureha Maru, a training vessel of the Toyama Prefectural Fisheries Institute, succeeded in adapting sea water to all canning purposes, thus eliminating the necessity of carrying vast quantities of fresh water. These experiments were so successful that in 1920 canning machinery was installed in the 175-ton sailing ship, Kureha Maru, which packed 300 cases that year. Thus, crabs were successfully canned at sea commercially for the first time.

In 1921 a total of 4,019 cases was packed aboard three sailing ships operating in the Sea of Okhotsk. By 1923, 17 vessels were in operation, of which nine were sailing ships and eight were steamers, having a total of 9,048 gross tons. These ships packed 22,996 cases of crab meat. All sailing factory ships were eliminated after 1924, and steamers as large as 2,831 tons were used (Table 6). In 1923 the Ministry of Agriculture and Forestry established a licensing system for factory ships as a conservation measure and limited the number of ships to 18. The use of nets with mesh less than 1⅜ inches, stretched, was prohibited. Fishing was restricted in the Sea of Okhotsk west of Longitude 150°E. Despite restrictions, the industry expanded so rapidly that production exceeded export demand, and in 1928 the Government ordered an amalgamation of the floating factory industry. Following this decree, all factory ships operating off the west coast of Kamchatka were placed under the control of either the Nippon Kosen Co or the Showa Kosen Co, and those operating off the east coast of Kamchatka in the Bering Sea were placed under the Higoeni Kosen Co, Ltd. All three companies were consolidated under the Nippon Godo Kosen Co, Ltd (Japanese Consolidated Floating Factory Co, Ltd) in 1932. The development of this amalgamation process through the years is indicated in Table J on page 29.

In 1930, the peak year of floating cannery production, 20 factory ships, having a gross of 63,975 tons, operated. Floating canneries in Okhotsk and Bering seas totaled 32,123 tons in 1934. They utilized 98 fishing boats, employed 2,790 fishermen and laborers, and produced 196,019 cases of crab meat with a market value of about ¥7,900,000. All activities were temporarily suspended in 1941. Only two factory ships operated in 1942, all others having been requisitioned by the Japanese navy. Operations finally were suspended during that year. The seven factory ships in use during 1939, which later were requisitioned by the navy, were sunk during World War II.

During the operation of the floating factories from 1920-42, 52 different ships engaged in canning crab meat. These ships ranged in size from the 68-ton sailing ship Fumi Maru to the 8,253-ton steamer Taisaka Maru. Some of the basic physical data regarding a large factory ship, the Toten Maru, are given in Table 7. Operational costs of factory ships are shown in Table K on page 30.

TABLE J. - CHRONOLOGY OF ORGANIZATIONS CONTROLLING THE FLOATING FACTORY CRAB CANNING INDUSTRY, 1930-45



SOURCE: Japanese company records

TABLE K. - OPERATING COSTS OF FACTORY SHIPS, 1938-42			
Year a/	Mother Ships	Total Operating Expense (yen)	Average Operating Expense Per Ship (yen)
1938	8	6,595,000	824,475
1939	7	5,551,000	793,000
1940	4	4,104,000	1,026,000
1942	2	2,362,000	1,154,000

a/ No operations in 1941
SOURCE: Japanese company records

Some factory ships operated during only a single season, but the 2,559-ton Mifuku Maru operated for 14 seasons and caught 21,653,717 crabs, a total pack of 351,682 cases, the largest total pack made by a single vessel. During the 22-year period (there was no pack in 1941 by floating factories), the floating canneries caught a total of 238,192,946 crabs, which produced a pack of 3,547,154 standard cases of crab meat. This was 41.3 percent of the over-all total of Japanese canned crab meat production.

A list of the factory ships engaged in canning operations from 1920-42, with their sizes, operational localities, and total pack, is given in Table 6. The total number of crabs taken annually from 1924-40, is given in Table L.

TABLE L. - NUMBER OF CRABS TAKEN BY FACTORY SHIPS, 1924-40	
Year	Number of Crabs
1924	4,019,600
1925	7,576,855
1926	12,645,371
1927	21,875,646
1928	19,204,794
1929	23,331,635
1930	24,028,935
1931	13,343,677
1932	11,264,642
1933	9,431,168
1934	9,910,499
1935	11,322,859
1936	14,883,109
1937	14,883,227
1938	18,488,065
1939	14,230,875
1940	8,607,978
TOTAL	238,192,946

SOURCE: Nichiro Fishing Co

Comparable figures are not available on the total number of crabs obtained for use by the land-based canneries. However, as the methods of catching, handling, processing, and packing are the same in both types of operations, the figures for the number caught by the floating factories may be used to estimate the number processed by land-based canneries. Factory ships processed 238,192,946 crabs for a pack of 3,547,154 cases. This pack equals about 41 percent of the total pack of all crab canning factories, and it may be assumed that the number of crabs used was also approximately 41 percent of the total crab catch. This indicates that the total number of crabs caught was approximately

581,000,000, of which the land-based canneries utilized some 343,000,000 crabs for 59 percent of the pack.

10. Total Production of Canned Crab Meat

The canned crab meat production of Japan by regions and by years from 1902-42, including both canneries and floating factory vessels, is summarized in Table 1. During this period, 8,579,525 standard cases were packed.

11. Export Trade and Domestic Consumption

Japanese crab export began in 1906 when canned crab meat was first shipped to the United States. The Tokyo earthquake and resulting fire destroyed records of exports to individual countries up to and including 1923, but the total export figures for that period are available in Table M.

TABLE M. - EXPORT OF CANNED CRAB MEAT, 1906-23

Year	Standard Cases	Yen Value
1906	ND	ND
1907	98	ND
1908	470	ND
1909	2,534	ND
1910	50,433	731,716
1911	66,299	938,962
1912	75,376	1,384,701
1913	81,060	1,468,551
1914	93,851	1,471,858
1915	135,335	1,578,780
1916	231,454	3,305,325
1917	275,657	4,454,247
1918	235,831	4,569,783
1919	148,198	3,020,657
1920	126,222	4,019,946
1921	125,125	3,238,415
1922	158,292	4,374,424
1923	152,645	3,996,401
TOTAL	1,959,779	38,551,766

ND: No data available
SOURCE: Nichiro Fishing Co

Data showing the distribution of the export from 1923 until the major foreign trade stopped in 1941 are given in Table 8. The export of canned crab meat to the United States increased steadily from 99,835 cases in 1924 to 284,704 cases in 1928. In that year Japan's exports to all countries totaled 509,586 cases. The world-wide depression in the early 1930's profoundly affected foreign trade. In 1934 canned crab exports to the United States had dropped to 115,516 cases. In an effort to maintain prices and to stabilize the market during this depression period, 200,000 cases of unsold crab meat were put aside and "frozen" in 1930. In order to handle the export industry, the Japan Canned Crab Mutual Sales Assn was organized and appointed as the sole agent of both the Land Producers and the Factory Ship Producers Assns. All export records to the United States were exceeded in 1939 when 406,003 cases out of a total export of 574,694 were shipped there.

Exports to England rose from 20,226 cases in 1924 to 144,910 cases in 1933, a figure which was not again attained. Australia, never a heavy importer, received 2,487 cases in 1924 and 23,995 cases in 1929. A drop to 950 cases followed in 1931, but a

steady increase prevailed thereafter until 1939. Exports to France fluctuated, dropping from 1,430 to 103 cases in 1926, rising to 69,006 cases in 1933, and falling to 9,676 cases in 1938. Exports to Belgium rose from 1,332 cases in 1927 to 11,629 cases in 1932, and remained fairly constant until 1940 when the export dropped to 2,871 cases. Exports to Germany, other European countries, and Canada began in the mid-20's, but none of these received more than approximately 9,000 cases in any one year. Exports to Central and South America began in 1927 with 1,170 cases but never reached 2,000 cases annually. The African trade began in 1933 with 1,162 cases and climbed to 6,759 cases in 1941.

The total canned crab meat export from 1907-23 amounted to 1,959,779 cases, worth more than ¥38,000,000. The yearly breakdown for this period is shown in Table M, together with the yen value for each year. The number of cases exported to various countries from 1924-43 is shown in Table 8 and Figures 12 and 13. Japan exported a grand total of 7,930,900 cases of canned crab meat (Tables M and 8) from 1906-43.

To present some evaluation of the importance of the export trade, Table 9 shows the value of the yen, and the value of the canned crab exported to the United States, the export value being $48,559,036 from 1924-39.

Exports from 1924-43 totaled 5,971,121 cases, while the domestic consumption for that same period totaled 648,198 cases, or 9.1 percent of the total pack for those as shown in Table N on page 34 and Figure 13. It is apparent that approximately 6.5 percent of the pack is not accounted for in existing figures.

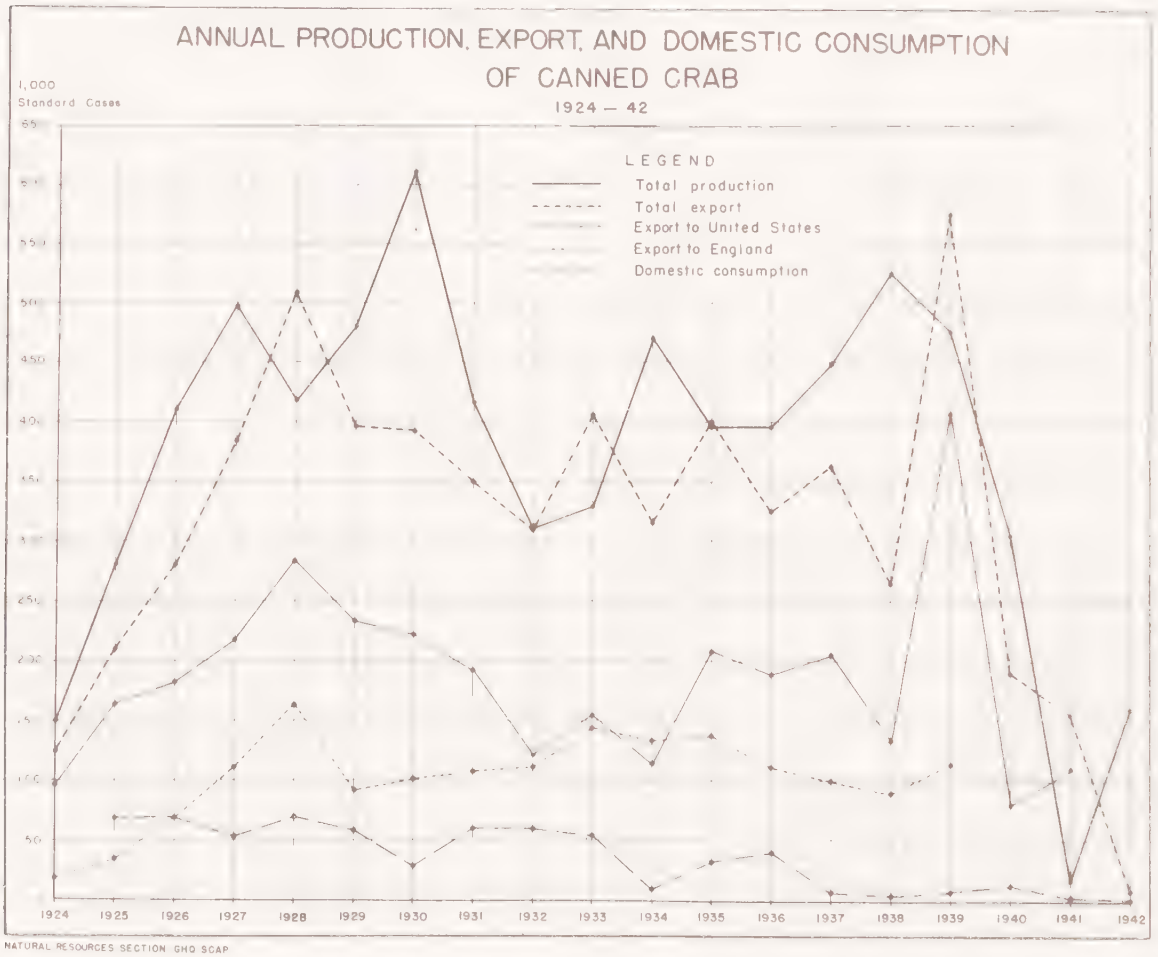
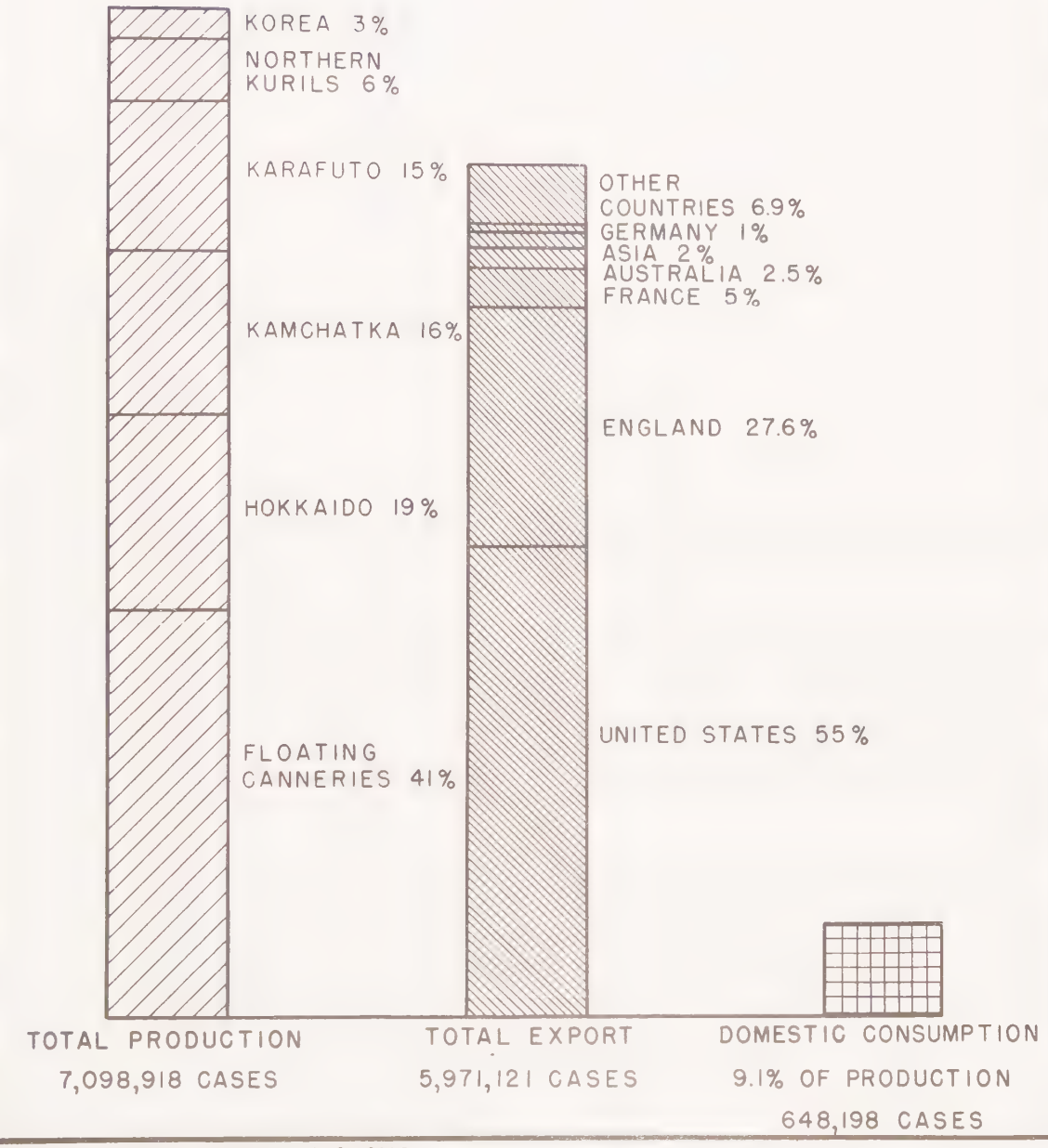


Figure 12

TOTAL PRODUCTION, EXPORT, AND DOMESTIC CONSUMPTION OF CANNED CRAB, 1924-43

(PERCENTAGE BREAKDOWN)



NATURAL RESOURCES SECTION GHQ SCAP

Figure 13

TABLE N. - DOMESTIC CONSUMPTION OF CANNED CRAB MEAT, 1925-43	
Year	Standard Cases
1925	65,000
1926	70,000
1927	54,553
1928	70,147
1929	59,716
1930	30,882
1931	60,005
1932	60,880
1933	56,360
1934	11,361
1935	33,679
1936	38,416
1937	8,253
1938	5,779
1939	7,501
1940	12,327
1941	2,912
1942	118
1943	318
TOTAL	648,198

SOURCE: Nichiro Fishing Co

OPERATION OF CANNERIES

1. Land-Based Canneries

The land-based canneries used kawasaki fishing boats originally driven by manpower, but later equipped with 10-horsepower engines. Larger boats of about 20 tons were used for fishing 30 to 40 miles off shore.

Ground tangle (gill) nets were utilized exclusively (Figure 14). By government regulations the minimum mesh size was 18 inches, stretched measure. The usual mesh had a stretch of 19 or 20 inches. Each "length" of net was 10 feet deep, 165 feet long at the top, and 153 feet long at the bottom. As the net functioned by entangling the long appendages of the crab, only the softest twine and the largest possible mesh that would not permit the crabs to escape were used. The net was made of No 6 cotton twine of medium lay. Glass balls 2½ x 3 inches in diameter attached by a casing of woven fiber to the upper or float-line of the net were used as floats. Stone sinkers weighing about 1½ pounds each were used on the bottom line. Each kawasaki boat carried approximately 500 such lengths of net.

The nets were usually set from 5 to 15 miles offshore and at depths ranging from 80 to 140 meters, depending on the season of the year and the locality. The nets were placed at an angle of 30 to the direction of the current. Generally 25 lengths were joined in linear series, and 10 of these "units" were placed in parallel rows to form one "set" of 250 nets. The exact number of lengths and units in a set varied with local conditions, but a set could consist of from 60 to 200 lengths (9,000-30,000 feet) of net. A 15-pound anchor was secured to each length, and a buoy keg or some other marker was placed between lengths of net. Fishing at a distance of 30 to 40 miles offshore was frequently necessary along the shores of Hokkaido where crabs are less abundant, and in such localities each set consisted of 150 to 200 lengths.

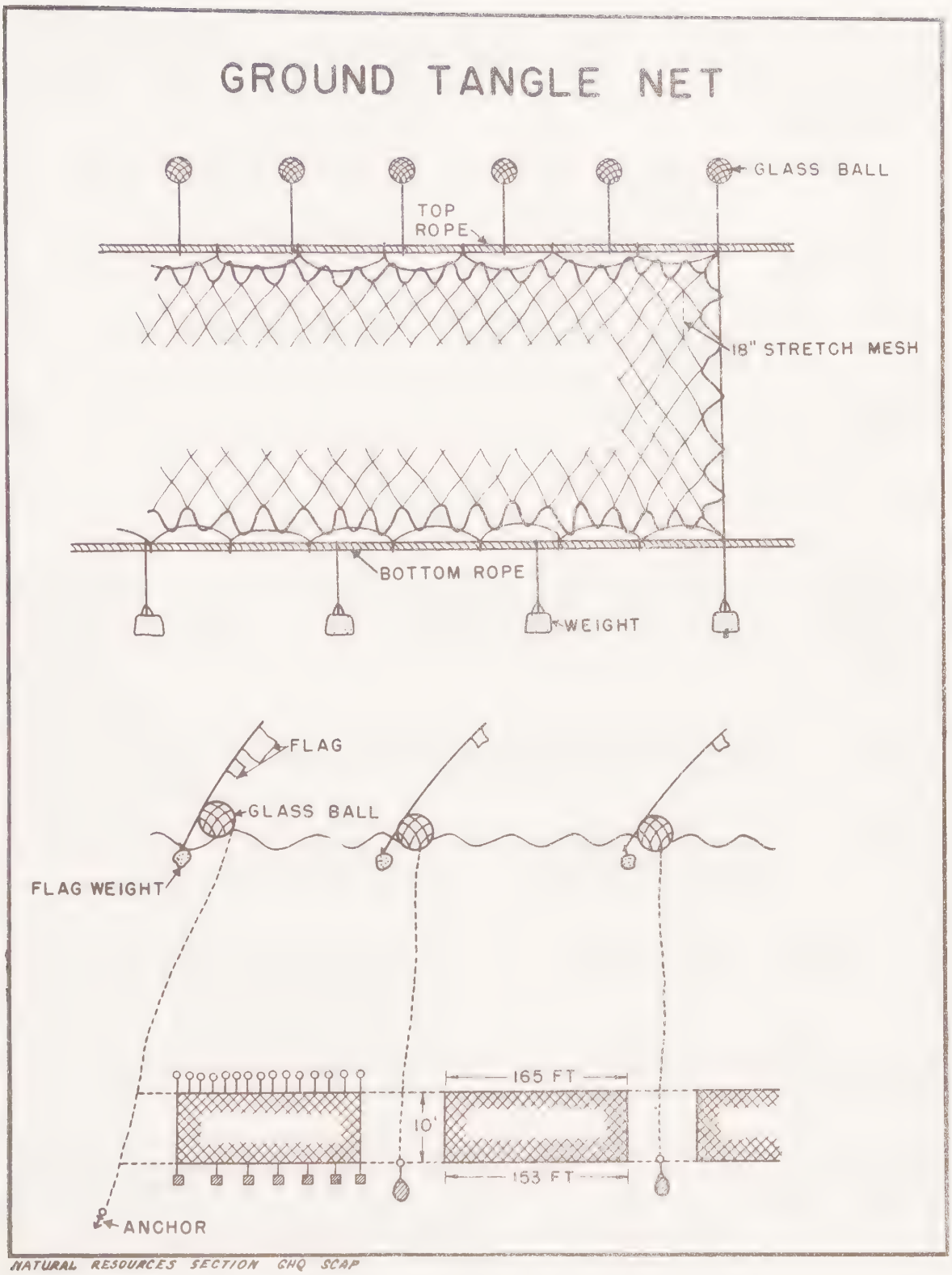

GROUND TANGLE NET
GLASS BALL
TOP ROPE
18" STRETCH MESH
BOTTOM ROPE
WEIGHT
FLAG
GLASS BALL
FLAG WEIGHT
165 FT
10'
153 FT
ANCHOR
NATURAL RESOURCES SECTION CHQ SCAP

Figure 14

After the nets were placed the set was left undisturbed from five to seven days, depending on local weather conditions. The nets were then hauled in slowly against the current, rolled up with the crabs entangled in the mesh, and brought ashore for delivery to the cannery. When time permitted, because of a long voyage or a light catch, the crabs were removed from the net aboard the boat, and the legs were separated from the bodies prior to landing.

The nets were unrolled at the cannery wharf and the crabs removed (Figure 15).

Figure 15

First the carapace was separated from the reminder of the crab by means of a two-pronged hook inserted in the eye sockets; then the legs and claws, with the attached shoulder meat, were pulled from the body by hand and placed in bamboo baskets. The loaded baskets were placed on track carts and pushed into the cannery shed. The meat in the legs and claws was canned, livers were sold for the manufacture of vitamin oil, and the rest of the crab was ground and dried for fertilizer.

Inside the cannery the clusters of legs were separated into component units by hand, placed in rope or wire baskets, and washed in cold sea water. They were then ready for boiling. The boiling tanks were wooden vats which had a steam coil at the bottom, were fed by live steam, and filled with cold sea water. The slings of legs were lowered into these vats, and the water was brought to a boil. The legs of large crabs were boiled 18 minutes and smaller ones 16 minutes. The slings were then raised, immediately swung into adjacent concrete tanks filled with sea water at about 8°C, and left there for 15 minutes. This immediate chilling set the meat, made it firm in texture, preserved the color, and caused sufficient shrinkage for quick removal of the meat from the shell.

After chilling, the legs were dumped on duck-boards for draining, then transferred to the first table. There the legs were separated, arranged in bamboo baskets, and passed to the cutting table where the shoulder meat was removed by scissors and the legs were cut into sections by a transverse incision at both ends of each segment, thus eliminating the joint. The meat was then shaken out by hand and the shell discarded. This meat was placed in separate bamboo baskets according to the segment of the leg from which it came. At the next table the segments were thoroughly washed by hand in clean sea water and placed in tin-plated trays; these were passed to the next table where the segments were trimmed, cut to size, and placed to drain in enamel trays with holes in the bottom.

At the fifth table small plastic trays of standard weight were used on scales adjusted to compensate for this weight. Four ounces of flakes were weighed out on the tray, which was then passed down a line and the following meat added: two or three pieces of No 1 segment, depending on thickness of the meat; two or three pieces of No 2 segment; two or three pieces of No 3 segment; and finally trimmings. Meat from the shoulder and large chela (pinchers) was added to the tray to a total weight of 16 ounces of meat. The trays

were then passed to the filling table where the meat was placed in paper-lined cans in the following order: one piece of No 1 segment at the bottom, two pieces of No 2 segment, and the meat from the chela. On top of this the flake meat was placed, then the remaining pieces of leg segment meat. The edges of the paper were then folded over the meat. Next the filled cans were carried by a traveling chain to a clincher machine where the lids were put on, then into a vacuum sealer where the air was exhausted and the cans sealed. The average speed of operation was about 120 cans a minute. The cans then were put on metal trays which were placed in a horizontal type retort. One-pound cans were sterilized for 80 minutes at 225-230° F, and half-pound cans were sterilized for 70 minutes at 220-227° F. After removal from the retorts, the cans were passed through concrete tanks filled with cold water and were further cooled on racks. All cans were inspected for proper weight before they were packed in wooden boxes for shipment. Underweight cans were eliminated. The lid was tapped with a small metal hammer, the resulting tone telling the accuracy of the weight of the pack. A difference of three grams above or below the stipulated weight was easily detected, even to the unskilled ear. The cans were then given one coat of clear lacquer. They usually were labeled after delivery to the wholesale buyer.

One of the early problems in canning crab meat was the discoloration or blackening of the meat, caused by the formation of iron sulfide. The meat contained combined sulfur, and sulfide developed as the meat became alkaline. The blackening resulted when this sulfide reacted with the iron of the can. This occurred only when the meat was alkaline (Oshima, 1931). To overcome this, at first a compound of sodium tartrate, tartaric acid, and sodium chloride was added. However, the alkaline condition and resulting discoloration actually occurred when the meat contained blood, and the difficulty has been eliminated by thorough washing to remove this blood.

In a general area the canning season lasted approximately six months and shifted from one locality to another as the crabs migrated. Individual canneries operated only two to four months on the average, depending on the local supply of crabs. Because of the limited operations in a given locality, cannery workers were employed for a period of four or five months a season. An average factory employed about 75 male and 200 female cannery workers. When a cannery closed, the workers were moved to another cannery where operations were starting. The average working day was 10 hours, and employees received a daily wage during the entire season, whether the factory was in operation or not.

Until 1937 the average seasonal earnings per person were ¥100-200 per fisherman, ¥120-150 per male cannery worker, and ¥100-120 per female cannery worker. By 1940 the rates had more than doubled. The standard daily wage in 1945 was:

TABLE O. - CANNERY WAGES, 1945

	Maximum	Minimum	Average
Male	¥12.50	¥6.40	¥7.84
Female	5.10	4.50	5.00

In addition to the cash pay, each worker received food and shelter, medical care, work clothes, and transportation to and from home. A "souvenir fish bonus" of one or two cases of sea food was given each employee at the close of the fishing season.

The prewar wholesale price of canned crab meat fluctuated around ¥50.00 per standard case. During the war years, materials necessary for packing crab meat were allocated by the Government. At first the price remained fairly constant. However, prices started their upward trend in 1944, and production costs in 1947 reached ¥6,019.98 per case. The trend of prices is indicated in Table P on page 38, and the breakdown of production costs in 1946 is given in Table Q on page 38.

TABLE P. - SALE PRICE OF CANNED CRAB, 1935-47 a/ (standard cases)	
Year	Tokyo Sale Price (yen)
1935	48.72
1936	50.46
1937	51.21
1938	47.82
1939	46.14
1941	50.30
1944	100.50
1945	858.32
1946	2,145.26 b/
1947	6,019.98 b/

a/ Years without significant change are omitted.
b/ Production cost; for sale price, add 10 percent.
SOURCE: Nichiro Fishing Co

TABLE Q. - PRODUCTION COST OF CANNED CRAB MEAT, 1946 (standard cases)	
Item	Percent of Cost
Raw material (crabs)	48.9
Labor	12.0
Cans, boxes, line	6.9
Other direct costs	7.0
Indirect costs	2.1
Overhead	23.1
TOTAL	100.0

SOURCE: Nichiro Fishing Co

2. Operation of Floating Canneries

Each floating cannery fleet consisted of one factory ship of 3,000-10,000 tons, two auxiliary motor vessels of 50-100 tons, and from 8 to 12 kawasaki fishing boats 35-40 feet long and powered by 10-horsepower motors. The personnel of each fleet totaled 350-450 men. Of these, 40-60 were crew members of the factory ship, 150 were fishermen, 150-200 were cannery workers, and 10-15 were clerical workers and executives as shown in Table R on page 39.

The kawasaki boats and their equipment and provisions were loaded on the factory ships at the base port of Hakodate, and the entire fleet made the trip to the fishing grounds in five to seven days. Upon arrival, the two auxiliary motor vessels surveyed the fishing grounds.

Each fishing boat was equipped with 1,000-1,500 lengths of net which were the same type and were set in the same manner as those described in connection with land-based canneries (Figure 16). Operation of the nets was timed so that 2,000-3,000 lengths were raised a day. Weather permitting, the crabs were sometimes removed from the nets aboard the kawasaki fishing boats, but in rough weather the nets were rolled with the crabs entangled and brought to the factory ship.

TABLE R. - PERSONNEL OF A CRAB FLOATING CANNERY FLEET
(S. S. Kasato Maru, 6,003 tons; 5 motor ships, and 10 fishing craft: 412 personnel)

Executive: Captain, mates, doctor, and chiefs of section: 15

Factory Ship Crew: 50		Fishing and Motor Boat Crews: 162		Factory Section: 185	
Clerical	9	Captains	15	Foreman	1
Deck	16	Engineers	15	Asst foremen	3
Engine room	25	Fishermen	132	Mechanics	3
				Separation legs	54
				Picking	17
				Boiling tanks	2
				Washing	5
				Meat sorting	20
				Weighing	14
				Filling	15
				Retorting	14
				Cooks	6
				Prepare liners	5
				Miscellaneous	26

SOURCE: Nippon Suisan KK

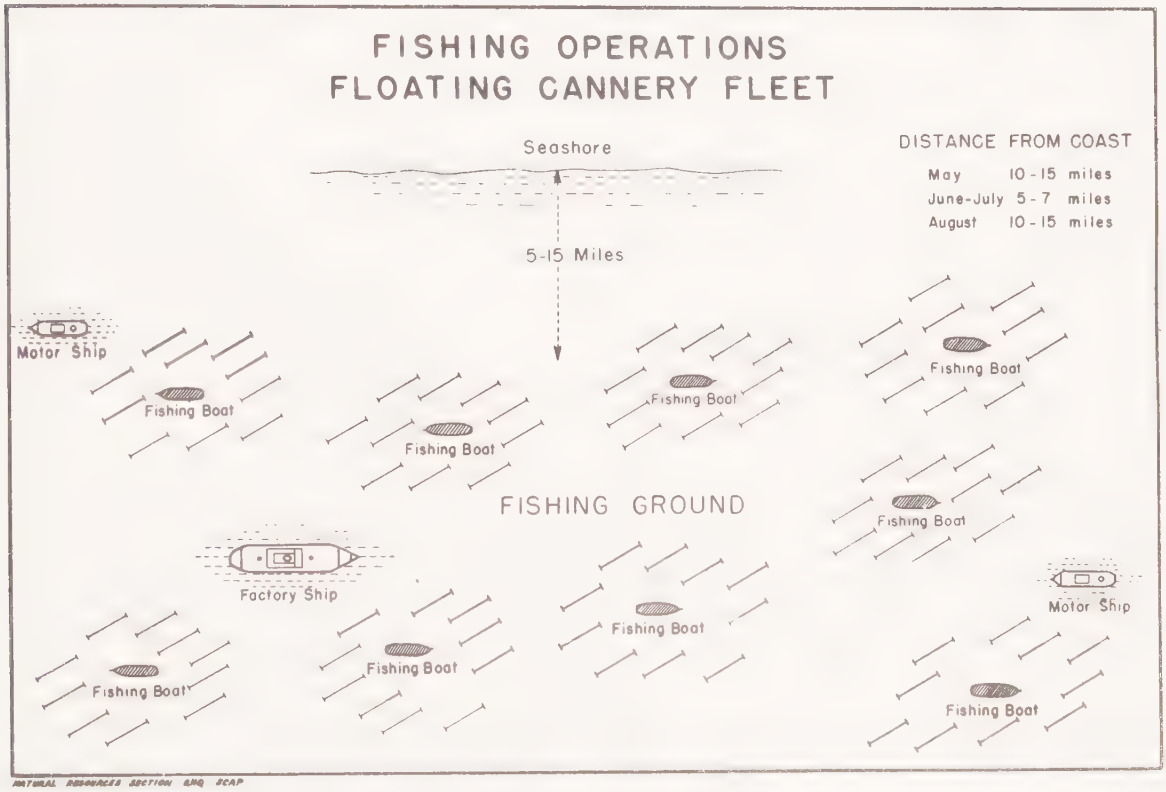


Figure 16

The canning process on a mother ship (Figure 17) was like that in a land-based plant except for a few minor details. For example, the boiled material was cooled by dipping the baskets into the sea instead of using concrete cooling tanks. After the canned pack had accumulated in the storage hold of the factory ship, it was transferred to motor launches or to special freighters which brought supplies to the fleet, and so transported to the home base.

Seven or eight floating canneries employing approximately 2,500 men were in operation from 1932-39. Six or seven fleets usually operated off the western coast of Kamchatka in the area extending from Latitudes 50°30'N to 57°N, while one or two fleets fished the Bering Sea from Kamchatka to the Aleutian Islands and Alaska.

The duration of the fishing season for factory ships was four to five months. The average working day for both fishermen and factory employees was 10 hours. An estimated 20 percent of the working days per season were lost because of rough weather and scarcity of raw materials. Until 1937 the total seasonal earnings per worker were ¥200-250 for fishermen and ¥150-200 for factory employees. These amounts had more than doubled by 1940 because of the currency inflation which followed the outbreak of the war with China. Employees of the floating cannery received the same subsistence and bonus payments as the land-based factory workers. Piece-work rates were not paid to employees, but a system of incentive payments was used. Consequently, individual incomes varied considerably. The total individual earnings consisted of a fixed wage, a production acceleration or incentive bonus, a transportation allowance, a dependent allowance, an experience bonus, and an efficiency or diligence bonus. This last-named bonus was a system of withholding wages until completion of satisfactory service, a system quite prevalent in Japanese industry.

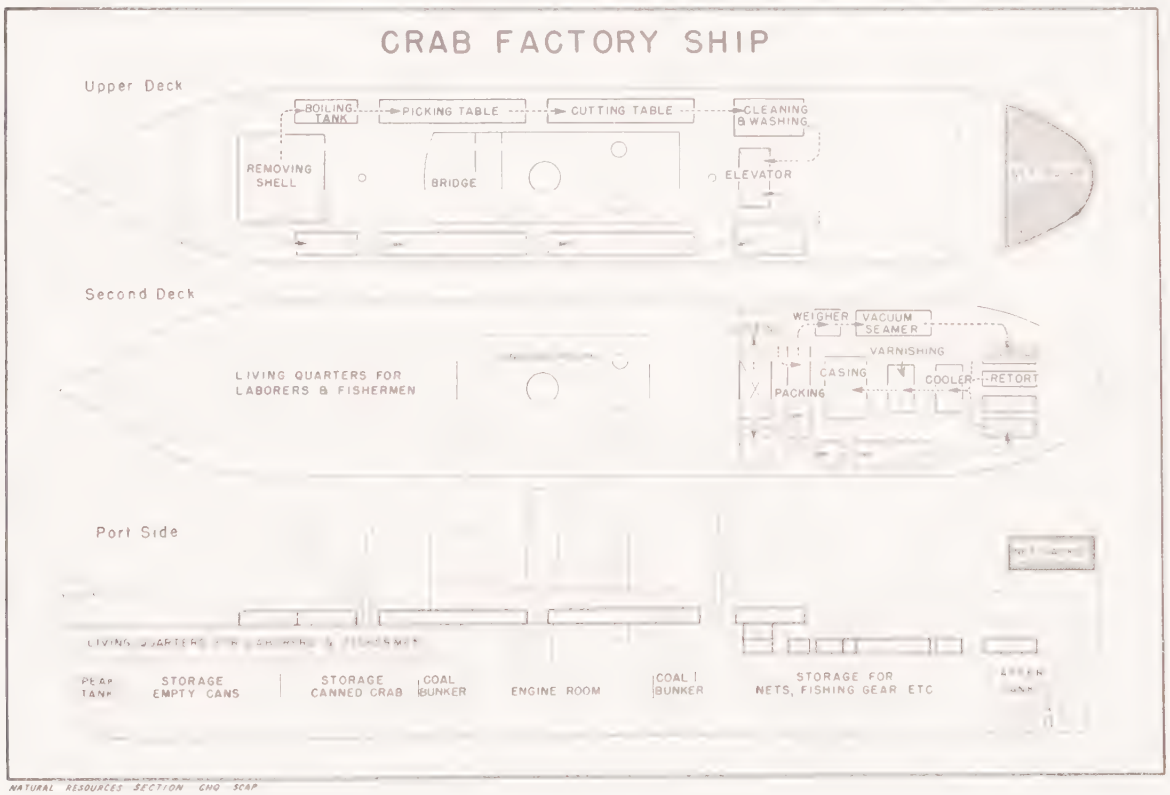


Figure 17

INSPECTION AND GRADING

During the early period of the industry, no system of inspection or quality control existed for goods destined either for domestic consumption or the export trade. As a result, the quality of the product and fill of the container was not consistent. Because of frequent complaints from foreign countries, an inspection organization, the Federation of Japan Crab Canning Industry, was created in 1923. This body, composed of technical experts, members of the industry, and representatives of exporting organizations, functioned under direction of the Ministry of Agriculture and Forestry. The main office was in Tokyo, and branch offices were in Yokohama, Kobe, Osaka, Hakodate, and Otaru. A standard for quality, grade, and fill of container was established. All lots of canned crab were examined and classified: "Fancy", "Fair", "Passed A Flake", "Passed B Flake", "Nonexportable", or "Rejected". The latter class was not to be sold for human consumption. The Federation also undertook control of sales and publicity.

This Federation was dissolved in 1942, and its functions were assumed by the Japan Export Canned Products Inspection Society under the Ministry of Commerce and Industry. This organization was replaced in 1943 by the Japan Canned Products Inspection Institute (Nippon Kanzume Kensa KK) under joint control of the Ministry of Agriculture and Forestry and the Ministry of Commerce and Industry. This institute had the sole function of inspection. Under stress of war conditions and with the disappearance of export trade, this federation was abandoned, and the Nichiro Fishing Co, the only actively operating agency, undertook inspection of its own products in 1944. This company simplified the regulations to include only three grades: "Passed for Export", "Nonexportable," and "Rejected".

Each lot of canned crab was examined and graded according to the following criteria:

a. Does the can have an identifying code mark?

b. Is the can well tinned and free of defect?

c. Does the label plainly show the name of the packer and the quantity of the net contents?

d. Does the can contain proper vacuum?

e. Does the can contain the proper proportion of all classes of meats?

f. Is the meat firm, of good flavor and luster, and free of foreign materials and discoloration?

g. Do the flakes and other meat of irregular size and shape make up no more than 25 percent of the net contents?

h. Are net solid contents (drained weight) no less than 180 grams per half-pound can?

Lots which failed to meet these requirements, but which were wholesome in quality, were graded as "Nonexportable"; material unfit for human consumption was classified "Rejected". Despite the nonspecific and purely subjective tests of grading, Japanese canned crab has a world-wide reputation for high quality and generous fill of container, a record equaled by few other canned marine products.

LACQUER AND PAPER SPECIFICATIONS

1. Can Lacquer

In the Japanese crab canning industry, "C" enamel is used exclusively to coat the inner surface of the can. This is prepared by mixing 3.4 kilograms of refined linseed oil

and 34 kilograms of Chinese tung oil in a 200-liter aluminum kettle and heating to a temperature of 200°C. Then 21 kilograms of a 30-percent oil-soluble phenol-formaldehyde resin are added and the mixture is stirred well and heated to 250°C. At this point 2.0 kilograms of glycerine are added slowly, and the temperature is raised to 285°C so that neutralization is completed and the glycerine is converted to glyceride by combination with the free acids in the mixture. The material is then cooled to 250°C, and manganese resinate is added as a drier. When the temperature falls below 120°C, the contents of the kettle are diluted with a mixture of two parts gasoline to one part turpentine until a 55 percent varnish solution is produced. Two kilograms of zinc paste (75 percent zinc oxide and 25 percent drying oil) are mixed with every 14.5 kilograms of this varnish.

The final product, "C" enamel, is applied to the surface of the sheets of tin plate with a roller printing machine in such a manner that the vehicle concentration is 95 milligrams per 100 square centimeters of surface. The lacquered sheets of tin plate are then baked in a Neward-type oven for 20 minutes at 205°-215°C.

2. Paper Liner

The parchment paper used as can liners must meet the following specifications:

a. It must be white, smooth, and tasteless.

b. It must be 0.002-0.0025 inches thick.

c. When boiled in distilled water, it must not color the water darker than slightly pale yellow.

d. When boiled in one percent sodium hydroxide, it must not produce color darker than light brown.

e. After boiling in distilled water, the pH of the solution must be neutral or slightly acid (pH 5.6 to 6.0), and the loss of weight of the sample of paper must not exceed one percent.

f. Chlorine contents must not exceed 0.05 percent.

g. Sulfuric acid content must not exceed 0.05 percent.

h. It must be free from dextrose and other reducing sugars (copper value below two).

Practically all cans, liners, and cases used by the crab canning industry have been supplied by the Tokyo Seikan Can Manufacturing Co of Otaru, Hokkaido, a modern plant having a capacity of 1,000,000 cans per eight-hour day. American Can Co machinery is used, and the factory floor plan and operations are indentical with those of a typical American Can Co plant in the United States.

BACTERIOLOGICAL STUDIES

The Japanese industry uses a sterilization temperature of 222°-230°F for canning crabs. This is considerably lower than the minimum sterilization temperature of 240°F which is required in canning marine products in the United States. Despite this fact, no recorded instance of food poisoning has been attributed to canned crab.

A study of the possible existence of Clostridium botulinus was made by the Fisheries Experimental Station and the Japanese Canning Cooperative Assn from 1927-41. From the cannery areas and fishing grounds, 146 bottom samples were taken at random from Karafuto to Formosa. These samples were collected under sterile conditions and then cultured anaerobically from the growth of C. botulinus. The samples were incubated for 10 days at

37°C and then for 20 days at room temperature. Mice were injected with 0.5 milliliters of the cultured material at the end of the 10-day period and again after 20 additional days of incubation. No deaths from botulism resulted, and no typical symptoms of toxosis were observed in any of the mice. Samples of the same material were inoculated with C. botulinus and cultured under indentical conditions. Mice which were injected with these samples developed typical symptoms of botulism and died within two days. On the basis of these experiments, the Japanese concluded that C. botulinus did not exist in the soil of the fishing ground bottoms where Japanese conducted shellfish fishing and in localities where canning was done. However, the adequacy of such studies is open to question.

BY-PRODUCTS OF CANNING

The three by-products of crab canning are fertilizer, livers, and amino acid sauce.

The shell parts, viscera, and other offal obtained in the routine of canning are sun-dried on the local plant premises and then ground and sold as fertilizer.

The livers, which are collected when the carapace is removed from the body, were sometimes salted and sold as an appetizer. Now however, all livers are sold directly and in the raw state to drug manufacturing companies for the extraction of valuable vitamin oil. Crab livers average approximately 7.5 grams in weight.

The spent liquid from the crab boiling tanks was utilized in preparing amino acid sauce. After approximately 2,000 crabs had been boiled, the liquor was removed to a tank which was equipped with steam coils and was concentrated to a consistency of 10° to 13°C. Salt was added until the concentration reached 17°-18°. In a second tank, wheat flour and potato starch were mixed with warm water, the mixture was cooled to 37°C, and Aspergillus mold added. This material was kept at 37°C for three days. The mold then was collected, transferred to the brine liquor tank, agitated thoroughly with the liquor, and the mixture stored at 40°C for 30 days. After fermentation, this mixture was filtered through a straw mat or cloth bag, and the filtrate heated at 100°C for 10 minutes. When cooled, the resulting material was placed in 18-liter wooden kegs. Approximately 36,000 liters of amino acid sauce were produced annually. Soybean flour and caramel coloring were added to the product to make a substitute soya sauce.

The economic value of the by-products of crab canning was insignficant, as indicated by the data in Table S. No detailed information on the production of amino acid sauce is available.

TABLE S. - BY-PRODUCTS OF CRAB CANNING

Year	Crab Shells (fertilizer)			Crab Livers	
	Number (bales a/)	Amount (pounds)	Value (yen)	Number (cans)	Value (yen)
1941	1,700	337,273	15,554	ND	ND
1942	2,049	376,063	16,712	ND	ND
1943	1,433	325,665	8,503	902	7,667
1944	1,839	364,886	12,891	ND	ND
1945	ND	ND	3,762	762	6,477
1946	1,058	209,907	91,245	588	48,150

a/ One bale is approximately 198 pounds.
ND: No data available
SOURCE: Nichiro Fishing Co

Ishii, S.
1929 Karafuto Kinkai San Taraba-gani Kihonchosa Hokoku (Report on the Study of the King Crab in the Coastal Waters of Hokkaido): Karafuto Shikenjo Jigyo Hokoku (Rept of the Fisheries Exp Sta, Karafuto Govt), no 6, pp 1-197, figs 1-15.

Kaijita, Y. and Nakagawa, K.
1932 Taraba-gani Chosa (Investigation of the King Crab): Suisan Chosa Hokoku, Hokkaido Suisan Shikenjo (Rept Hokkaido Fisheries Exp Sta), no 27, pp 1-163, pls 1-15.

Marukawa, H.
1919 Kaiyogyojo Chosa Hokoku: Kamusakka Seigan ni Okeru Chosa (Marine and Fisheries Investigation in the Sea of Okhotsk): Gyogyo Kihonchosa (Fund Fisheries Res Imp Fisheries Inst), vol 5, no 1, pp 89-150, figs 1-5.

1933 Taraba-gani Chosa (Researches on the King Crab): Jour Imp Fisheries Exp Sta, no 4, pp 1-152, pls 1-19.

Nakazawa, K.
1912 Hokkaido Taraba-gani ni Tsuite (On the King Crab of Hokkaido). Dobutsugaku Zasshi (Zoological Magazine), vol 24, no 279, pp 77-128.

Okamoto, S.
1944 Kanikanzume hattatsu shi (History of Crab Canning): Kasumigaseki Shobo (Kasumigaseki Book Co), pp 1-1855.

Oshima, K.
1931 Studies in Crab Canning, US Dept Comm Bur Fisheries Investigational Rept, no 8, vol 1, pp 1-8.

1936 The Fisheries in the Northern Waters of Japan, Reprinted from Dai Nippon, Tokyo, pp 1-14, figs 1-3.

Sato, S.
1939a Getsurei to Taraba-gani no Jyuryo Tono Kankei ni Tsuite (On the Relation Between Lunar Age and Weight of the King Crab): Suisangaku Zasshi (Jour Fisheries), no 43, pp 17-22.

1939b Hokkaido-Kinkai ni Okeru Taraba-gani no Ido Oyobi Keito ni Tsuite (On the Migration and Stock of King Crabs of Hokkaido): Hokkaido Suisan Shikenjo Junpo (10-Day Rept Hokkaido Fisheries Exp Sta), pt 1, no 424, pp 5-8; pt 2, no 424, pp 4-6; pt 3, no 425, pp 3-6.

1943 Taraba-gani Zoea Shiiku Shiken (Experiments on Breeding of Zoea of the King Crab): Hokkaido Suisan Shikenjo Junpo (10-Day Rept Hokkaido Fisheries Exp Sta), pt 1, no 559, pp 1-6; pt 2, no 560, pp 7-12; pt 3, no 561, pp 13-22.

Sato, S. and Tanaka, S.
1943 Hokkaido-Kinkai-San Taraba-gani no Kyakucho no Hen-i ni Tsuite (On the Length and Variation of the Legs of the King Crab in the Seas Adjacent to Hokkaido): Hokkaido Suisan Shikenjo Junpo (10-Day Rept Hokkaido Fisheries Exp Sta), no 572, pp 10-14.

Takenouchi, H.
1935 Taraba-gani Chosa Hokokusho (Report on the Study of the King Crab): Norinsho Suisankyoku (Jap Bur Fisheries Pub), pp 1-36, figs 1-7, pl 1-21.

TABLE I — PRODUCTION OF CANNED CRAB MEAT BY REGIONS, 1902–42

(STANDARD CASES a/)

Year	Hokkaido and Southern Kurils	Northern Kurils	Karafuto	Kamchatka	Floating Canneries	Korea	Others	Total
1902	500	0	0	0	0	0	2,610	3,110
1903	250	0	0	0	0	0	0	250
1904	104	0	0	0	0	0	0	104
1905	213	0	0	0	0	0	0	213
1906	1,606	0	0	0	0	0	0	1,606
1907	3,099	0	0	0	0	0	0	3,099
1908	6,008	0	0	0	0	0	0	6,008
1909	18,029	0	9,100	0	0	0	0	27,129
1910	20,765	0	19,809	0	0	0	0	40,574
1911	27,552	0	25,525	0	0	0	0	53,077
1912	27,291	0	37,387	0	0	0	0	64,678
1913	33,287	0	29,502	0	0	0	0	62,589
1914	33,484	0	50,925	0	0	0	0	84,409
1915	29,381	0	33,586	0	0	0	0	62,967
1916	36,247	10,820	108,808	0	0	0	0	157,065
1917	46,212	10,712	117,515	0	0	0	0	174,439
1918	41,884	3,337	93,793	0	0	0	0	138,814
1919	35,304	3,625	45,030	0	0	0	0	84,379
1920	39,376	8,006	26,028	4,839	300	0	0	78,549
1921	46,053	10,742	22,731	20,379	4,019	0	0	103,924
1922	54,657	15,485	36,283	16,351	8,317	0	0	131,093
1923	65,170	21,339	61,706	40,729	22,996	0	0	201,926
1924	59,453	7,085	26,238	37,592	36,583	0	169	150,136
1925	34,857	7,858	26,238	83,968	108,568	0	4,599	281,088
1926	45,330	8,438	16,866	110,504	235,085	3,000	10	408,429
1927	34,184	8,721	4,002	156,211	291,021	6,060	0	495,898
1928	34,888	11,382	3,400	106,335	337,358	19,000	0	419,963
1929	37,000	15,000	45,931	107,000	258,000	39,000	1,640	503,571
1930	34,000	8,731	64,190	55,943	165,834	57,000	115	415,813
1931	38,507	8,405	34,007	64,084	240,207	9,000	1,393	410,021
1932	49,672	ND	29,590	47,154	173,526	9,000	1,210	310,152
1933	48,180	5,621	34,895	24,712	163,286	12,000	31	330,877
1934	39,000	5,471	44,517	28,648	140,019	21,000	832	471,772
1935	47,906	12,906	42,982	33,962	146,311	26,844	1,375	306,286
1936	88,493	35,435	19,169	49,641	184,838	19,596	53	397,225
1937	70,769	56,183	22,993	78,028	204,000	15,648	124	447,745
1938	67,846	64,669	42,780	79,180	251,596	19,775	12	525,858
1939	52,972	69,033	57,559	77,393	203,990	13,443	0	474,390
1940	33,108	51,107	36,232	54,847	122,400	6,914	0	304,608
1941	0	0	0	11,285	0	6,076	0	17,361
1942	39,395	34,937	7,094	19,819	50,919	ND	0	152,164
TOTAL	1,638,133	484,251	1,279,074	1,331,334	3,547,151	285,356	14,293	8,579,525
PERCENT OF TOTAL	19.1	5.6	14.9	15.5	41.3	3.3	0.3	

a/ 48 one-pound cans
ND: No data available
SOURCE: Japanese Canned Goods Control Co

TABLE 2.— CATCH OF TARABA CRABS IN KARAFUTO, BY COUNTIES, 1914–40

(UNIT: INDIVIDUAL CRABS)

Year	Country							TOTAL
	Shikuka	Mototomari	Toyohara	Otomari	Honto	Maoka	Tomarforu	
1914	30	ND	ND	30,805	241,638	878,330	2,816	1,153,619
1915	ND	ND	ND	105,336	333,034	1,369,188	15,960	1,823,518
1916	ND	ND	ND	214,600	1,303,057	2,567,547	576,430	4,661,634
1917	560	650	ND	443,456	1,093,456	1,605,572	1,978,365	5,131,900
1918	65	ND	18,300	381,255	781,142	872,062	1,524,018	3,576,873
1919	80	ND	158	454,993	284,000	416,656	539,892	1,775,779
1920	210	ND	53,896	262,079	124,094	366,886	167,451	974,616
1921	ND	ND	78,418	138,037	196,117	618,647	37,617	1,069,836
1922	ND	ND	129,330	158,622	388,893	1,739,137	10,642	2,426,624
1923	ND	ND	102,168	346,219	945,239	3,295,321	116,588	4,764,535
1924	ND	ND	36,662	88,602	433,556	827,522	113,309	1,500,151
1925	ND	76,700	29,534	202,970	209,811	460,457	60,497	1,044,969
1926	ND	57,460	14,740	431,210	12,860	269,150	16,019	801,439
1927	1,500	78,440	30,669	273,520	4,386	268,765	34,366	691,646
1928	8,000	63,480	41,300	14,350	100	186,808	36,933	365,171
1929	18,796	67,912	146,689	211,652	2,620	1,508,104	52,373	2,328,086
1930	10,000	76,000	39,800	202,566	102,366	1,596,408	773,758	2,801,098
1931	12,000	77,783	98,534	222,550	204,296	1,754,199	376,486	2,745,848
1932	146,566	121,057	240,350	594,667	179,149	556,237	121,173	2,958,199
1933	76,100	89,275	302,426	270,558	141,242	1,[illegible]	516,842	3,[illegible]
1934	840,248	371,020	421,346	243,961	96,879	1,[illegible]	1,[illegible]	4,[illegible]
1935	1,[illegible]	74,692	78,396	20,836	420	934,[illegible]	243,[illegible]	3,[illegible]
1936	1,339,566	9,150	13,720	25,200	ND	2,470	12,800	1,402,906
1937	1,261,[illegible]	14,380	253,[illegible]	83,350	879	61,283	27,660	1,[illegible]
1938	N	7,350	2,[illegible]	30,[illegible]	55,268	1,[illegible]	288,517	1,[illegible]
1939	N	5,200	17,[illegible]	142,[illegible]	126,862	1,214,[illegible]	787,989	2,[illegible]
1940	ND	400	35,000	10,147	ND	1,139,711	139,796	1,325,054

ND: No data available
SOURCE: Nichiro Fishing Co

TABLE 3.— DATA ON CRAB FISHING GROUNDS OFF EASTERN KAMCHATKA
(OPERATIONS OF ONE SHIP, 1939)

Date	Locality	Extent of Operating Area (square miles)	Depth (meters)	Type of Bottom	No of Sets Operated a/	No of Crabs Caught
19-20 May	Latitude 56°51'N Longitude 162°00'W	40	45 - 48	Fine sand	1,020	6,120
21-22 May	Latitude 56°25'N Longitude 162°25'W	2	45 - 48	Fine sand	40	0
24-25 May	Latitude 56°01'N Longitude 161°35'W	2	27 - 37	Gravel	40	25
29 May-5 Jun	Latitude 56°30'N Longitude 161°17'W	25	43 - 45	Hard sand	520	2,440
6- 7 Jun	Latitude 56°26'N Longitude 161°35'W	20	43	Fine sand	420	3,400
9-22 Jun	Latitude 56°15'N Longitude 161°25'W	30	30 - 35	Fine sand	1,200	8,200
28 Jun-5 Jul	Latitude 56°20'N Longitude 160°58'W	18	32 - 36	Fine sand	710	6,000
6-13 Jul	Latitude 56°34'N Longitude 160°20'W	12	34 - 36	Fine sand	620	1,180
13-15 Jul	Latitude 56°51'N Longitude 161°02'W	10	27 - 44	Fine sand or gravel	130	90
15-29 Jul	Latitude 56°48'N Longitude 161°02'W	60	44 - 50	Fine sand	2,055	5,300
2- 3 Aug	Latitude 55°40'N Longitude 163°00'W	2	45 - 49	Sandy clay	40	18
3- 4 Aug	Latitude 55°20'N Longitude 163°35'W	2	45 - 48	Fine sand	50	110
4- 5 Aug	Latitude 55°08'N Longitude 164°30'W	1	60	Fine sand	20	0
8- 9 Aug	Latitude 58°20'N Longitude 162°30'W	2	18 - 20	Fine Sand	50	0
11-12 Aug	Latitude 60°09'N Longitude 172°10'W	3	41 - 44	Rock	50	0
14-15 Aug	Latitude 62°02'N Longitude 178°50'W	3	55 - 60	Gravel	50	0
25 Aug-11 Sep	Latitude 62°04'N Longitude 177°55'E	100	50 - 60	Gravel	3,700	10,980

a/ A "set" is a unit of 250 nets, each net being 164 feet long.
SOURCE: Data obtained by Kuren Maru, 19 May-11 Sep 1931 and submitted by Nippon Suisan KK.

TABLE 4— JAPANESE FACTORY SHIP OPERATIONS IN ALASKAN WATERS
1930-40

Year	Factory Ship	Subsidiary Vessels a/	Total No of Crew	Operations		Days of Operations	Total No of Sets b/	Average No of Crabs Obtained per Set	Total Crabs Caught	Standard Cases Processed
				Started	Ended					
1930	Taihoku Maru c/	E 1; K 10	496	18 Jun	29 Sep	120	180,000	7.3	1,330,022	28,745
1931	d/	d/	d/	d/	d/	d/	d/	d/	d/	d/
1932	Nagato Maru	E 2; K 8	390	7 May	16 Sep	126	222,780	6.2	1,278,280	34,359
1933	Taihoku Maru	E 3; K 10	381	3 May	29 Sep	146	300,126	3.7	1,137,126	27,992
1932	Shohei Maru	E 2; K 8	344	4 May	27 Sep	144	275,439	6.1	921,144	21,411
1933	Shinano Maru	E 1	221	17 May	20 Aug	16	ND	ND	9,411	227
1933	Kasado Maru	E 5; K 10	463	8 Jun	2 Jul	10	ND	ND	7,960	199
1934	Taihoku Maru	F 2; K 13	425	2 May	1 Oct	152	413,465	2.4	1,006,071	21,713
1934	Toten Maru	ND	ND	4 May	3 Aug	80	173,985	1.9	330,487	8,909
1935	Ryokai Maru	E 3; K 10	394	3 May	14 Sep	139	341,524	2.3	746,450	15,825
1935	Taihoku Maru	T 3; JS 8; K 3	529	10 May	3 Sep	106	246,461	2.8	13,245	360
1936	Toten Maru	E 3; K 10	338	27 Apr	16 Jun	50	127,918	2.2	280,900	7,549
1936	Taihoku Maru	T 5; JS 4	596	1 May	8 Sep	12	ND	ND	0.496	18
1937	Toten Maru	E 3; K 10	343	17 Apr	1 Jul	75	217,110	2.2	485,900	12,809
1937	Taihoku Maru	T 3; JS 10; K 4	642	1 May	11 Sep	35	ND	ND	30,970	375
1938	Toten Maru	ND	ND	18 Apr	24 Jun	72	236,171	1.9	411,030	13,385
1939	Toten Maru	ND	ND	17 Apr	ND	40	125,500	1.9	241,781	6,206
1940	Kasado Maru	● E 3; K 10	461	15 Apr	6 Aug	126	325,255	7.4	2,461,430	34,829
1940	Bifuku Maru	E 3; K 8	355	ND	ND	123	227,796	7.7	1,769,995	27,240
1940	Hakuai Maru	E 2; K 8	348	ND	ND	124	236,321	8.8	2,081,745	28,500
1940	Wakanoura Maru	E 2; K 8	349	ND	ND	124	248,017	9.2	2,294,500	31,831

a/ E, motor-powered boat; K, kawasaki hand-powered boat; T, trawler; JS, Japanese seiner, Danish type. Trawlers and seiners used facilities aboard factory ship for the manufacturing of fish meal.
b/ A set is a unit of 250 nets, each net being 164 feet long.
c/ Experimental operations
d/ No operations
ND: No data available
SOURCE: Nichiro Fishing Co

TABLE 5 — KOREAN CRAB PRODUCTION
1912-42

Year	Crab Catch a/		Canned Crab Pack	
	Amount (metric tons)	Value (yen)	Standard cases	Value (yen)
1912	337	22,000	ND	ND
1913	1,117	98,000	ND	ND
1914	1,196	85,000	ND	ND
1915	1,319	83,000	ND	ND
1916	1,716	91,000	ND	ND
1917	1,668	107,000	ND	ND
1918	2,302	208,000	ND	ND
1919	1,491	144,000	ND	ND
1920	934	141,000	ND	ND
1921	1,361	150,000	ND	ND
1922	1,594	151,000	ND	ND
1923	1,189	143,000	ND	ND
1924	1,304	169,000	ND	ND
1925	1,185	126,000	ND	ND
1926	2,406	194,000	3,000	45,000
1927	3,242	176,000	6,060	120,000
1928	3,980	365,000	14,000	280,000
1929	5,824	298,000	35,188	422,000
1930	7,767	178,000	57,000	757,000
1931	5,565	187,000	8,000	114,000
1932	4,135	215,000	3,000	17,000
1933	5,860	216,000	21,000	333,000
1934	6,000	177,000	24,000	281,000
1935	6,998	258,000	34,000	369,000
1936	7,340	466,000	19,000	289,000
1937	11,456	684,000	154,048	645,000
1938	14,423	838,000	39,000	365,000
1939	15,836	912,000	154,143	379,000
1940	13,147	693,000	6,914	169,000
1941	11,240	801,000	6,000	185,000
1942	14,512	458,000	ND	15,000
TOTAL	101,057	6,575,000	385,246	6,197,000

a/ Includes crabs used for fertilizer, dried crabs, crabs used for domestic consumption, as well as those canned. Numerous species are involved here.
ND: No data available
SOURCE: Korean Fisheries Statistics: 1935, 1937, 1942.

TABLE 6— FACTORY SHIPS, SITES OF OPERATIONS, AND PACK, 1920-42 a/
(STANDARD CASES)

Ship b/	Tonnage	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Kureha c/	175	A 300	A 1,260	A 1,035	A 1,212				2,130	A 594	BC 1,624	
Kiku c/	300		A 647	A 1,996	D 1,281							
Kita	389		A 2,062									
Hohu c/	385			A 2,382	A 1,349							
Toshi I	588			A 1,234	D 3,565							
Hokushin c/	213			A 67	A 492							
Asahi	721				A 357							
Chishima c/	191				A 949							
Fumi	68				A 231	A 4,152			B 3,645		A 20,450	
Toshiwa	2,080				D 4,819							
Yoshino-yama	480				D 1,489							
Miho	487				D 3,525							
Taihei c/	602				D 2,400							
Nippo c/	348				A 1,200							
Ichikawa c/	171				D 1,215							
Nampo c/	178				A 1,058							
Higo	1,242				A 4,883	A 8,356	A 8,178	A 12,202	A 15,361	A 13,963	A 13,518	A 11,304
Hozan c/	480				A 2,024	A 4,088						
Karafuto	2,231					A 15,279	A 20,350	A 26,887	A 31,532	A 29,463	A 26,666	A 25,085
Moji	2,051					A 3,502	A 16,687	A 20,000		A 25,528	A 22,506	
Ryukoku	2,217					A 1,216		A 16,408	A 17,304			
Chichibu	1,540						A 9,606					
Ryoyo	265						A 15,611			A 17,000		
Eiko	244						A 12,229	A 13,197	A 13,924			
Hokoku	290						A 13,675					
Fokuichi	263						A 11,732		A 18,434	A 15,529	A 19,511	
Mifuku	2,589							A 23,275	A 33,350	A 26,228	A 28,555	A 25,544
Toyokumi	2,342							A 21,023	A 18,371			
Fuku	2,162							A 23,260				
Ryoto	2,323							A 16,586	A 18,736	A 19,985	A 21,264	A 21,088
Jinju	2,778							A 19,200	A 23,621	A 28,322	A 25,829	A 24,294
Itsukushima	3,864							A 21,486	A 27,276	A 32,611	A 28,260	A 37,169
Hakuai	2,615							A 21,561	A 21,959	A 18,160	A 25,141	A 23,226
Kanton												
Eitoku	2,949									A 18,214	A 24,294	A 24,069
Fuzan	4,413								A 24,067		A 22,810	A 21,729
Sapporo	2,433								A 21,502	A 23,917	A [illegible]	A 23,033
Wakanoura	2,408								B 873			
Kwantong	2,566									A 24,439	A 28,542	A 26,350
Hachiro	2,808									A 18,214	A 24,294	A 23,042
Sanuki	5,861										B 20,929	[illegible]
Tomi	2,841											[illegible]
Taihoku	2,263											[illegible]
Shohei	2,108											[illegible]
Jimbu	2,263											[illegible]
Nagato	3,814											[illegible]
Etoro	2,287											[illegible]
Totan	2,424											[illegible]
Hokusui	2,424											
Ryokai	4,641											
Hokushir	5,750											
Kasato	4,005											
TOTAL		300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Continued

TABLE 6— FACTORY SHIPS, SITES OF OPERATIONS, AND PACK, 1920–42 a/ (CONT'D)
(STANDARD CASES)

Ship b/	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1942
Kureha c/											
Nikko c/											
Arita											
Hoko c/											
Tsuni I											
Hokushin c/											
Asahi											
Shishima c/											
Fumi											
Toshima											
Tsuno-yama											
Mihe											
Taihei c/											
Nippo c/											
Ichikawa c/											
Nampo c/											
Migo											
Hozan c/											
Karafuto	A 25,505										
Moji											
Kyukoku											
Chichibu											
Ryoyo											
Eiko											
Hokoku											
Fokuichi											
Mifuku	A 26,316		A 17,116	A 18,327	A 23,913	A 20,736	A 23,692	A 31,960	A 31,510	C 27,240	
Toyokumi											
Fuku											
Ryoto	A 21,612										
Jinju	A 22,045	A 16,606	A 19,068	A 24,109	A 24,151	A 28,884	A 28,746	A 32,304	A 29,242		
Itsukushima	A 24,008	A 23,309									
Hakuai		A 20,902		A 21,119	A 20,359	A 28,569	A 28,191	A 33,740	A 27,423	C 28,500	A 21,850
Kanton											
Eitoku											
Fuzan	A 25,836	A 25,898	A 20,191	B 12,755	A 23,292						
Sapporo											
Wakanoura											
Kwantong	A 25,387	A 22,156	A 19,552	A 24,355	A 24,317	A 20,091	A 25,721	A 29,240	A 26,500	C 31,831	
Hachiro											
Sanuki											
Tomi	A 36,501	A 30,396	A 27,956	A 27,538							
Taihoku			B 27,992								
Shohei		C	C	C 21,713							
Jimbu			C 21,411								
Nagato											
Etoro	A 33,002	C 34,359									
Toten				C 11,892	C 14,444	C 19,402	C 17,697	C 22,720	C 21,455		A 26,069
Hokusui				A 24,711		A 21,950	A 26,350	A 27,022			
Ryokai					B 15,835	A 23,989	A 27,059	A 36,331	A 31,864		
Hokushin						A 25,217	A 26,543				
Kasato								A 38,279	A 36,006	C 31,890	
TOTAL	240,207	173,526	153,526	196,019	146,311	184,838	206,000	251,596	203,000	122,400	50,319

a/ Legend:
A Off west Kamchatka: Sea of Okhotsk
B Off east Kamchatka: Bering Sea
C Off Alaska and Aleutian Islands
D Off Maritime Province

b/ Ships operated only during years indicated. No operations were carried on in 1941.

c/ Sailing vessel

SOURCE: Okamoto, 1944. Based on reports submitted to Floating Factory Assn by individual factory ships.

TABLE 7.— DATA ON TYPICAL CRAB FACTORY SHIP, TOTEN MARU

	Gross tonnage: 3,823.22 tons Net tonnage : 2,387.48 tons Year built : 1900		
Hull	Material : Steel No of decks : 2 Construction: Double bottom	Principal dimensions: Length: 335 ft Beam : 43 ft Depth : 29 ft	
Engine	Main boiler	Tube type No of cylinders : 2 Working pressure: 170 lb	
	Steam engine	Triple expansion engine : 1 Indicated horsepower : 1,041 HP Coal consumption per day: 28 tons	

NA: Not applicable
SOURCE: Japanese company records

Dead weight : 6,179 tons
Loading capacity: 6,179 tons

Load Measurements

	No 1 Hold	No 2 Hold	No 3 Hold	No 4 Hold
Hatchway Length and breadth (feet)	24 x 16	28 x 16	24 x 16	24 x 16
Winch Capacity (tons)	2	1.5	1.5	1.5
Number	2	2	2	2

Position of Space	Exposed Part of Upper Deck (cu ft)	Bow Turret (cu ft)	Interior Turret (cu ft)	Stern Turret (cu ft)	Second Deck (cu ft)	Hatch (cu ft)
Deck & hold	4,300	240	1,738.8	290	11,258.5	8,418.7
Inner hatch	NA	1,680	10,171.6	2,030	82,185.0	175,505.0
Outer hatch	NA	1,720	22,792.0	8,958	88,958.0	186,234.0

TABLE 8.— EXPORT DISTRIBUTION OF CANNED CRAB MEAT BY COUNTRIES, 1924-43 a/

(STANDARD CASES)

Year	U S A	Canada	Hawaii	England	Australia	France	Germany	Denmark	Sweden	Belgium
1924	99,835			20,226	2,487	1,430				
1925	165,856	1,673	3,963	35,716	4,885	1,129				
1926	182,106	3,256	2,919	69,745	9,313	103	4,544	4,252	300	
1927	217,756	5,393	6,207	112,125	13,821	2,816	4,361	9,247	1,552	1,332
1928	284,704	6,068	3,882	163,120	18,211	10,447	3,949	7,934	141	4,260
1929	233,283	5,040	3,258	91,554	23,995	12,767	4,478	8,156	413	5,122
1930	223,283	2,757	2,928	102,580	15,764	26,854	1,041	4,350	0	3,310
1931	193,206	2,963	3,083	107,503	950	26,960	776	4,288	0	5,683
1932	122,517	1,640	2,564	111,543	6,015	41,613	2,070	3,288	355	11,629
1933	155,111	856	1,076	144,910	5,243	69,006	3,857	3,984	100	16,017
1934	115,516	1,149	1,050	134,414	9,892	26,473	5,365	859	499	11,875
1935	208,044	4,426	1,280	138,882	6,867	7,569	7,627	231	529	14,753
1936	154,231	4,114	1,149	112,739	6,662	13,811	7,078	473	911	15,711
1937	205,115	1,538	1,937	101,994	5,811	19,834	7,564	92	862	10,937
1938	133,668	1,730	1,824	88,073	4,719	9,676	594	146	500	11,365
1939	406,003	2,609	1,652	113,688	6,864	14,567	4,963	187	187	11,159
1940	81,673	823	1,882		7,964	10,874	0		162	2,871
1941	107,090		955				30		235	3,010
1942										
1943										
TOTAL	3,288,997	46,035	41,609	1,648,812	149,463	295,929	58,297	47,487	6,716	129,034
PERCENT OF TOTAL	55.00	0.77	0.69	27.60	2.50	4.95	1.00	0.79	0.10	2.00

Year	Holland	Greece	Other Europe	Africa	Cen & So America	Oceania	Asia	Manchuria & China	Others	Total
1924										123,978
1925									6,166	219,388
1926									3,426	279,964
1927	705	2,926			1,170	2,034		1,821	317	383,613
1928	1,114	1,624			1,187	500		1,831	614	509,586
1929	1,442	4,428			1,492	357		1,672	947	398,404
1930	678	2,210			1,425	229		1,121	1,138	389,668
1931	895	2,136			495	107		768	865	350,678
1932	1,328	1,234			675	114		2,034	1,132	309,751
1933	2,070	656	127	1,162	378	200		3,482	0	408,235
1934	1,824	835	524	1,463	684	198	180	1,759	0	314,559
1935	2,065	1,212	844	1,638	1,186	222	245	1,469	58	399,147
1936	1,316	399	342	1,809	1,955	242	315	2,565	0	325,822
1937	1,317	161	703	1,291	1,473	334	198	1,834	0	362,995
1938	1,507	633	504	1,057	1,303	217	165	6,493	0	264,174
1939	2,097	895	408	1,742	1,262	386	328	5,597	0	574,594
1940	50		100	1,304	1,638	3,102	59,449	8,191	60	180,143
1941				6,759	1,557	1,204	33,660	1,101	32	155,633
1942							6,436			6,436
1943							14,353			14,353
TOTAL	18,408	19,349	3,522	18,225	17,880	9,446	115,329	41,738	14,785	5,971,121
PERCENT OF TOTAL	0.30	0.30	0.06	0.30	0.29	0.15	2.00	0.69	0.20	

a/ Exports were shipped only in periods indicated.
SOURCE: Nichiro Fishing Co

TABLE 9.— VALUE OF CANNED CRAB EXPORTED TO UNITED STATES a/

Year	Average Value of Yen (cents) b/	Value of Total Export (yen) c/	Value per Exported Case (yen) c/	Value of Export (dollars)
1907	49.437	ND	ND	ND
1908	49.437	ND	ND	ND
1909	49.500	ND	ND	ND
1910	49.437	731,716	ND	ND
1911	49.312	938,962	ND	ND
1912	49.437	1,384,701	ND	ND
1913	49.375	1,468,551	ND	ND
1914	49.250	1,471,858	ND	ND
1915	48.625	1,578,780	ND	ND
1916	50.062	3,305,325	ND	ND
1917	50.875	4,454,247	ND	ND
1918	51.500	4,569,783	ND	ND
1919	50.875	3,929,657	ND	ND
1920	49.125	4,019,946	ND	ND
1921	48.062	3,238,415	ND	ND
1922	48.000	4,374,424	ND	ND
1923	48.750	3,956,401	ND	ND
1924	43.500	4,885.565	39	1,693,700
1925	41.000	10,059,224	46	3,128,044
1926	46.856	12,517,343	45	3,839,741
1927	47.425	14,661,390	39	4,027,560
1928	46.457	18,573,579	37	4,893,802
1929	46.069	16,712,489	42	4,513,788
1930	49,367	14,477,697	37	4,078,440
1931	39.375	12,158,632	35	2,662,620
1932	28.120	10,750,407	35	1,025,812
1933	25.227	19,586,689	45	1,770,843
1934	29.511	16,638,494	49	1,670,406
1935	28.570	21,280,107	50	2,971,908
1936	29.000	17,288,408	47	2,102,168
1937	28.814	21,331,736	54	3,191,499
1938	28.496	17,005,139	58	1,447,421
1939	25.984	32,350,700	53	5,591,278
TOTAL		299,700,315		48,559,036

a/ Based on export to the United States and on the average value of the yen figured to the nearest whole yen
b/ Investigation Section, Yokohama Specie Bank
c/ Figures furnished by the Nichiro Fishing Co
ND: No data available

The End.